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EDITORIAL COMMENT

Medical Application of Genetic Theory

The contention is easy to defend that the acquisition of knowledge for knowledge's sake is a sufficient goal. Mendel's epoch-making experiment on the inheritance of flower color is a case in point. Yet knowledge for knowledge's sake becomes slightly esoteric, an intellectual luxury, when any practical results from pure science are not applied to the welfare of mankind. This in some measure is the relationship of genetics to medicine. Important theoretic knowledge has been amassed, but there is insufficient clinical application of it.

Why is this? There are two reasons; the prime one is the regrettable ignorance of practicing physicians about genetics leading to lack of faith in its dictates. It is probable that not a single leader of medical thought, older men who have risen to pre-eminence in their respective fields, was taught a word about human genetics during his years of medical school. Recent graduates from a few schools have had a course in the subject and when age bestows upon them the cloak of leadership, the situation may improve. However, medical genetics will not attain its full clinical application until this discipline is as much an integral part of medical curricula as electrocardiography or minor surgery.

A second retarding influence stems from the fact that the clinical application of human genetics often has a legal aspect, for example, such procedures as therapeutic abortion, contraception or sterilization. Long ago medicine surrendered its leadership in these specific areas to the Church, which framed existing statutes before human genetics became of age and now uses its unabridged power to thwart any change. This unqualified surrender to the Church will require decades of assault by legal, social, medical and genetic scientists before any breach can be made in the restrictive barriers.

Yet attempts are being made. I was an invited guest recently at a meeting in New York City of the American Law Institute, where the current "antiquated abortion statutes" were under scrutiny. Those present were representative liberal leaders of the American Bar, most of them professors of law at the great law schools of this country; others were judges, active and retired. The abortion statute of New York State prescribes that under certain conditions pregnancy may be terminated before a fetus is capable of survival if "done to save the life of mother or child." How abortion can save the life of a child is not apparent. The laws of most other states omit reference to salvaging the fetus but otherwise are similar. A few use the phrase "to preserve the health of the mother." Even the most liberal American statute makes no reference to any eugenic consideration. The study group took cognizance of this omission and is planning to frame a model statute to include eugenic considerations as well as maintenance of the mother's health. One of the group suggested that a pregnancy, legally proved

the result of incestuous relations, be included under eugenic indications. The majority opinion was expressed by Judge Learned Hand, who deemed it safer to crawl before trying to walk. The conclusion was that it would be wiser to concoct a pill small enough for a legislator to swallow, rather than one so large that it would stick in his gullet.

A somewhat similar group of physicians, sociologists, lawyers, biometricians, zoologists, public health officers and coroners met at Arden House in the late spring of 1955 under the auspices of the Planned Parenthood Federation to consider the abortion problem, its illegal and legal ramifications. Their deliberations will soon be published. In them one will find the same urgent emphasis on the legal recognition of certain eugenic grounds as indications for therapeutic abortion.

Most readers know that so respectable and widely used a procedure as contraception is legally banned in the Commonwealth of Massachusetts and the State of Connecticut. In each the physician is constrained by law from even advising any mechanical or chemical means of birth control to a woman who has produced hemophiliac sons, a mother of amaurotic idiots, or parents whose children are fatally affected by pregnancy iso-immune reactions. Yet it is legal in these jurisdictions to employ less well-tried medical techniques, such as a polio vaccine or heart surgery.

In many states the legal status of sexual sterilization is quite ambiguous. In twenty there is no law either forbidding or sanctioning the procedure. In the remaining twenty-eight states there are statutes, but most legalize the sterilization of the mentally deficient. Country-wide the status of voluntary sterilization on any other eugenic grounds is ill-defined and the operation is only infrequently performed for genetic indications other than mental deficiency. Furthermore, all but the more courageous physicians are intimidated from taking any positive action in matters which lack unanimity of social acceptance for fear of gaining the opprobium of medical colleagues.

The only solution is for the genetically oriented scientist and layman to take medicine to task for its perpetual ignorance in this field and for its reactionary unwillingness to apply it to human welfare.

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GENETIC AND EUGENIC ASPECTS OF EARLY TOTAL DEAFNESS*

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THE CLINICAL SYNDROME KNOWN AS "DEAFMUTISM" is highly complex in its etiology and equally perplexing in its effects on individual and group patterns of adjustment. Whether it occurs sporadically or as a familial trait, it causes distress not only in the person affected, but in all the other members of his family, hearing or nonhearing. The ensuing problems are boundless and pose challenging tasks to various professions and scientific disciplines.

To the geneticist, the question most commonly presented is how to advise a hearing person with deaf relatives, who asks "is there a possibility that my children will be deaf?" Other difficulties arise when a deaf person contemplates marriage with a hearing partner and wishes to know whether they may have nonhearing children. Equally important are choices of action in the areas of education, vocational guidance, and social integration.

One of the basic problems is prevention, which in turn depends on adequate knowledge regarding the etiology of the defect. In view of the fact that nearly 55 per cent of total deafness cases are assumed to have a nonhereditary basis (1), recent medical advances in the management of acquired types of deafness have underscored the need for similar progress in the genetically determined forms of the condition. Thus, although heredity is only one of the various causative factors in *early total deafness,* it is likely to become increasingly important in the years to come.

Statistics

Total deafness has a world-wide distribution varying from 0.23 per 1000 population in Germany to a supposed high of 4 per 1000 inhabitants in the Cayman Islands (2). In the United States the frequency is estimated at 0.8 per 1000, placing the total population in the neighborhood of 128,000 totally deaf individuals. According to Kemp (3), the incidence of deafness is somewhat higher in males than in females. In the total deaf population of the United States, nearly 94 per cent are supposed to have been afflicted before the age of eight years (including 40 per cent with congenital deafness).

It has also been estimated that about 47 per cent of the American deaf population marry and, as a rule the mates come from the same group. Marriages in which one or both partners are deaf tend to be nearly one-half as productive of children as those contracted by a comparable group of hearing couples (1).

Terminology

Loss of hearing covers a wide range, from the mildest forms referred to as "hard of hearing" to that of total or profound deafness. When the latter develops after the individual has learned to speak, *i.e.,* after age 7-8, it usually is not accompanied by subsequent loss of speech. The clinical

*This is the third report on a study of deafness, which is aided by a grant from the Office of Vocational Rehabilitation of the U.S. Department of Health, Education, and Welfare.

picture of "deaf-mutism" results only when total deafness occurs prior to the age when speech is learned. Such children are unable to acquire speech in the manner "normally" attained in our culture, *i.e.*, through hearing sounds. They appear mute although all their organs of speech are normal. To be sure, "deaf-mute" is a misleading term, traceable to an old misconception. It probably arose from the Aristotelian belief in a common brain center for hearing and speech, an idea that persisted throughout the middle ages. Total loss of hearing as the primary feature of "deaf-mutism" was recognized only in the 16th century, by the Italian physician, Girolamo Cardano (4), although the same idea had already been suggested by the ancient Roman naturalist, Pliny the Elder.

The fact that the organs of hearing and speech are anatomically and functionally separate has been confirmed by the results of modern education, which enables apparently "deaf-mute" individuals to learn useful speech. Whether "deaf-mutism" is due to environmental or hereditary factors, it is only deafness as such that has a direct anatomical origin. "Mutism" represents a cultural phenomenon. It is preferable, therefore, to refer to this condition as congenital or *early total deafness.* Those who have lost their hearing completely, after age 7-8 (when speech is usually established), may be designated by the term "deafened" (5) to distinguish them from those with partial hearing losses occurring at all ages (hard of hearing).

Anatomy and Function of the Ear

The organ of hearing comprises, anatomically, the outer ear, the middle ear, and the inner ear. The outer area consists of the large flap-like auricle that superficially collects the sound wave stimuli traveling through the auditory canal to the middle ear. The latter structure includes the membranous ear drum plus a cavity which is bridged by three small bones. In addition, there is the Eustachian tube which equalizes pressure (on both sides of the ear drum membrane) and helps to drain infections into the pharynx. The essential organ for hearing is found within the inner ear, an area including the spiral canal (cochlea) which differentiates the various sound tones and conveys them to the auditory nerve by way of the vital organ of Corti. The auditory nerve transmits these sounds to the acoustic center of the brain (temporal lobe) where they are translated into meaningful sound. In addition, the inner ear contains three semicircular canals, concerned mainly with the sense of equilibrium.

Conduction deafness results when the external canal and middle ear are affected. Perception deafness occurs when the sensitive spiral canal, the organ of Corti, or the auditory nerve is defective. Prognostically, the conductive type of deafness is likely to respond positively to operative, technologic (hearing aids), and pharmacologic treatments. Perceptive deafness, on the other hand, has thus far proven refractory.

Causes and Transmission

As noted earlier, deafness is apt to result in "mutism" only if it is total or nearly so and occurs before the normal establishment of speech. Congenital deafness is responsible for almost half of these cases. Partial hearing loss in childhood and total deafness developed later in life are severe handicaps, too, but they rarely produce "mutism."

Environmental factors may produce either conductive or perceptive deafness. The former type occurs especially in babies born deaf to mothers who have had metabolic disorders such as hypothyroidism or goiter. Other possible causes are infectious diseases during the pregnancy such as scarlet fever, German measles or syphilis; severe injuries before or during birth; and ear infections during infancy. The perceptive form of deafness is observed in individuals following infectious diseases such as meningitis, mumps, typhoid fever,

or syphilis; vitamin deficiencies (Vitamin D); injuries from explosions or blows on the ear; shock and other traumatic sequelae; and certain drugs (streptomycin, quinine, or arsenic).

In contrast with these acquired forms of deafness, the hereditary types are usually perceptive in nature. The exact mode of transmission of the genetic factors producing the conductive type of deafness is as yet unknown, probably in part because only a few forms of hereditary deafness have been described which affect the areas concerned with conduction. One of them is "endogenously" produced bilateral atresia of the external auditory canal. Another may be based on a genetic predisposition to bilateral chronic otitis media.

Otosclerosis, characterized by hardening of the tissues of the labyrinth, usually occurs after puberty and therefore accounts only for a very small proportion of cases of *early total deafness.* Genetically, the condition may be transmitted either as a simple recessive or an irregular dominant. According to Davenport *et al.* (6), two dominant genes may be at work, one carried by an autosome and the other linked to the sex (X) chromosome. This theory was devised in order to explain why otosclerosis occurs almost twice as frequently in women as in men.

Equally controversial are the genetic mechanisms producing the various types of perceptive deafness. One form is known as congenital hereditary-degenerative dominant inner ear deafness. The condition is characterized by incomplete development of the spiral canal with some changes in the sense elements and nerve. Although generally appearing at a later age, there are some reports of cases with *early total deafness* (7). As indicated by the name, it is considered to have a dominant type of inheritance. Hammerschlag (4), however, suggests that the condition is sometimes inherited in conjunction with three other disorders and may be transmitted by a polygenic type of inheritance or a recessive triple allelic system.

Sporadic recessive deafness, the most commonly reported form, is associated with a defective development of the auditory nerve and is believed to be transmitted as a single-factor trait (3). The condition may occur together with several other disorders, indicating the possibility of a true genetic relationship. It is assumed, for instance, that sporadic recessive deafness when it occurs with retinitis pigmentosa is produced by pleiotropic gene action (4).

Early total deafness may also associate itself with mental retardation, but the genetic basis of this concurrence (due to the same or to different genes if both conditions are genetically determined) is not known. Equally unclear is the hereditary background of the syndrome distinguished by deafness, mental retardation, and retinitis pigmentosa. In the opinion of Hammerschlag and others, the three traits represent a clinical entity, while Steinberg goes further by attributing the syndrome (adding the condition of cerebellar ataxia and specifying amaurotic idiocy as the given form of mental retardation) to a genetically determined metabolic (lipoid) disorder (4). However, Albrecht negates these views by suggesting that the various afflictions are inherited independently.

Finally, the deafness group classified as apparently "exogenous" (nonhereditary) in origin may include some forms which are actually based on a genetic predisposition to environmentally induced deafness. Modern genetic concepts do not preclude such a close interrelationship between heredity and environment. The outward (phenotypic) expression of a gene may not manifest itself until the proper environmental milieu is present. Thus the problem of causation in this form of deafness is considerably complex and at present not readily amenable to analysis.

Theories of Gene Action

Contrary to earlier interpretations of the mode of transmission of *early total*

deafness as due to polygenic factors, it seems justified to think of deafness in the same way as of many other pathologic traits of mutational origin. Hence, the condition may be produced either by a recessive or dominant factor affecting a particular area of the auditory apparatus. It would then be possible to assume in some cases a one-to-one gene action, but in most instances, the process of gene action is probably much more complicated. As to the primary question of mutations resulting in deafness, they may occur at one given locus with a single character effect, at various loci and in different families. A similar clinical picture of deafness may thus be caused by several genetic factors.

The following possibilities are indicated by family studies concerned with deafness:

1. A gene mutation occurring at one locus may be either recessive or dominant in expression. According to Waardenburg (8), there is fairly good evidence for the occurrence of a dominant autosomal mutation producing deafness. However, it is more difficult to demonstrate that deafness with a recessive autosomal inheritance arose by mutation. Family pedigrees must be traced to the original source, *i.e.*, to the time of the occurrence of the mutation, and this has been done only in some isolated inbred families. Various geographic foci have been unearthed in connection with these observations. (7) The mutation frequency at the particular locus may be high, as the genes, being unstable, tend to mutate.

2. The gene responsible for a specific type of deafness may show much variability in respect to its expression. It may be noted that two hereditarily deaf parents are known to have had deaf and nondeaf children. This finding may be attributed to the variable expressivity of the recessive gene. Actually, Waardenburg (8) assumed a penetrance (frequency of gene in a population) value of 20 per cent. for dominant hereditary deafness, and he theorized that another 80 per cent may be carriers of the gene showing either late deafness or no effect of the presence of the dominant gene. In one pedigree of dominant deafness he found two examples displaying unilateral congenital deafness, which may be another form of incomplete expression.

Other variations in expressivity may be exemplified by a differential in the time of appearance of the character produced by the gene. It is known that there is an enormous spectrum or "reaction norm" of gene activity in the degree of hearing as related to both time of onset and intensity. When total loss of hearing occurs either congenitally or before speech is fully established, the phenotype will present the clinical syndrome of *early total deafness* (with inability to speak without special instruction). However, when either mild loss of hearing occurs during this period or mild or severe loss of hearing appears later in life, the result will be a picture of deafness without subsequent speech problems (deafened).

3. The gene may show variations in regard to specificity. The phenomenon of specificity refers to the qualitative nature of variations in gene action. The same gene may appear as a dominant, an irregular dominant skipping generations (pseudo-recessive), an intermediate, or a recessive gene. These differences may merely depend on the lapse of time from the appearance of the mutant gene in any one family line.

4. Various other combinations may present themselves. Thus the syndrome of *early total deafness* may represent parallelism of action of various independent genes, with pedigrees showing matings between two deaf people, one with a recessive and the other with a dominant gene. In this case, children with normal hearing may be expected. In other instances, where both parents are heterozygous for a similar recessive gene, hearing and deaf children may be produced.

Pedigree Studies

The identification of those types of *early total deafness* which are genetically determined may be effected by the study of the incidence of the condition in family groups. Pedigree charts of such families are also helpful in recognizing cases of apparently exogenous causation, in demonstrating consanguinity, and in detecting that the legal parents may not be the biological ones. Other important factors to be determined are the mode of transmission (simple recessive, dominant, or polygenic) and the degree of expressivity. Genetically, of equal importance is the question of an inherited predisposition to ostensibly acquired forms of deafness. It is always advisable, of course, to evaluate pedigrees with respect to all of these questions. Unless the mode and degree of transmission of a given genetic factor have been adequately determined, the geneticist will not be able to answer the questions posed by interested families or their physicians.

Counseling Problems

The high proportion of genetically determined cases of deafness (45.5 per cent according to Lindenov) (4) serves to emphasize the need of understanding hereditary background factors in any program involving the prevention of this affliction. The prospects of achieving this goal are within the realm of future possibilities, despite the possible operation of a very high mutation rate in the etiology of this trait (Kemp) (3). A positive approach is possible, if only because it has been shown that consanguinity is a very important factor in raising the frequency of the condition in modern populations. If intrinsically-deaf persons would refrain from marrying near relatives, this factor alone would materially reduce the incidence of the condition.

Systematic efforts to integrate rather than to isolate the deaf (through encouragement of marriages between deaf and nondeaf individuals) would also be of substantial help in lowering the frequency of deafness in the population. Though it might be theorized by some that this procedure would "spread" the genes throughout the population in a heterozygous form and eventually would produce more and not less deaf offspring, this threat does not seem to be of foreseeable importance. Since some cases of deafness are probably based on a hereditary predisposition to externally precipitated deafness, it is apparent that precautionary measures may serve to prevent the phenotypic expression (deafness) of the gene in predisposed persons.

The magnitude of the problems faced by the deaf in our society is seriously aggravated by the fact that they are unable to communicate with hearing individuals by speaking. It should be emphasized again that almost all of those classified as congenital or early cases of deafness possess both anatomically and physiologically normal organs for the production of sounds and that with special education the so-called "deaf-mute" individual can learn to speak. In addition, he may be taught to read lips, which also may partly compensate for his deafness.

Instead of being a burden upon our society, a "deaf-mute" capable of communicating through speaking and reading lips should be able to obtain various types of employment denied to him today. The prospect of a productive life could not fail to alleviate the severe emotional problems of the deaf (feelings of frustration and social isolation) and society would be certain to benefit as the deaf become more useful and better-integrated members of the community.

The most important eugenic problems of deafness are posed by marriages between deaf individuals and by those between deaf persons and close relatives (whether hearing or deaf). Apart from discouraging consanguineous marriages in families with

cases of deafness, childless marriages might be considered if one or both partners are known to be genetically deaf. This procedure would have the advantage of preventing both the spread of the genes in the population and the possible creation of emotional problems in families composed of both deaf and hearing individuals. Negative aspects of a eugenic program advocating childless marriages would be the emotional problems arising in a childless home, and the possible elimination from the population of advantageous genes carried by deaf persons. This dilemma is common to all cases of genetically determined traits when eugenically motivated solutions are sought (9), and requires careful study and individual evaluation.

It is justified to say, therefore, that the problem of deafness is a complex one. It is regrettable that today we are able only to answer a few of the questions posed by deaf families. However, progressive programs of research leading to the establishment of adequate counseling procedures (10)-(11) should help us to provide the solution to these and many other problems.

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RESEARCH ON INTELLIGENCE AND PERSONALITY*

I. Introduction

The need for a broader conceptual framework in research on the genetic aspects of intelligence and personality was discussed in an editorial by Gardner Murphy in *Eugenics Quarterly* 1:4, December, 1954. The editorial stimulated correspondence. Thereupon, the Board of Directors of the American Eugenics Society in May, 1955 authorized Dr. Frank Lorimer to arrange for an exchange of ideas among a few persons interested in this subject. The others invited to serve as members of this committee are: Gordon Allen, M.D., New York State Psychiatric Institute; Dr. John L. Fuller, Roscoe B. Jackson Memorial Laboratory; Dr. Gardner Murphy, Director of Research, Menninger Foundation; Dr. Harry L. Shapiro, Curator of Anthropology, American Museum of Natural History; and Professor William R. Thompson, Psychology Department, Queens University. The committee met at 230 Park Avenue, New York City, October 21, 1955. Mrs. Helen Hammons, Managing Editor of *Eugenics Quarterly*, attended as an observer.

Dr. Gardner Murphy opened the discussion with a statement about the complexity of the interacting genetic and environmental factors in both cognitive and temperamental attributes. The nature of the problems encountered here requires the pooling of knowledge and techniques by geneticists, social scientists, physiologists, and psychologists in devising appropriate research programs. The most important task of the American Eugenics Society is to further an increase of knowledge in this field, and the Society is in a position to give "an integrative leadership" in this undertaking.

*First Report of Committee of the American Eugenics Society on Research on Intelligence and Personality, April 1, 1956.

II. Resumes on Selected Aspects of the Field

Brief résumés of information and suggestions on some aspects of this elusive field are presented here. The first of these résumés, by Professor William R. Thompson, begins with a consideration of the value for genetic investigations of units determined through factor analysis of data on animal behavior, and proceeds to the statement of some more basic principles.

Factors in Animal Behavior and Their Relation to the Study of Inheritance

The problem under consideration concerns the usefulness of factor analysis as a technique for finding units of animal behavior amenable to genetic analysis. Since all behavioral domains approached are initially very complex, it seems essential to try to find out more unitary traits or abilities that are likely to show relatively simple modes of inheritance.

Factor analysis—the most obvious method available—has, in fact, been applied by a number of investigators to animal learning, drive and emotionality. However, as Royce has shown in a review of the literature, the results of these studies are rather disappointing. The factors that have emerged are undetermined and difficult to interpret. For these reasons Tolman has felt that animal abilities and traits are multitudinous and very specific. This may well be true of "naive" animals. But it is not necessarily true of sophisticated or highly experienced animals. It is quite possible that with continued experience in testing situations, a rat or other laboratory subject will show increasing ability to transfer skill gained in one situation to new situations. The "learning sets" developed by monkeys in Harlow's laboratory

seem to indicate clearly that this may happen. The more tests given to a monkey, the more it is able to solve ensuing tests quickly and easily. It has learned how to learn. Another way of putting this is to say that general abilities develop only with practice, so that they cannot be expected to appear in naive animals faced for the first time with a battery of tests.

If factors do develop with practice, the next question that arises is what these factors may mean genetically. To answer this, we need to consider the possible genetic meanings that a correlation between two variables may have.

There appear to be three such possible meanings and these have been labeled *chromosomal communality, gene communality* and *selection communality*. The first of these refers to linkage, that is, the case where genes carrying the two traits are on the same chromosome and assort together under certain mating conditions. The second meaning is identical with genetic or physiological pleiotropy and refers to the dependence of the two traits on common genes or on some common physiological or biochemical process itself governed by a number of genes. The third case is perhaps the most interesting. Here the communality between the two traits is developed through selective cross-homogamous mating in the population. When there is a tendency for individuals high on one trait to mate with individuals high on the other trait, a correlation will arise between the two traits in a few generations, even though the traits were orthogonal to begin with. Many factors of human ability and personality may be of this nature, and in such cases we could not expect to find any simple genetic solution.

On the basis of the above analysis, some recommendations can be made concerning fruitful lines of research in psychogenetics with animal subjects.

1. An investigation of how factors develop (if they do) with increasing experience and sophistication of the subjects.

2. Studies comparing behavior factor patterns obtained with naive and with sophisticated subjects.

3. Studies of the inheritance of factors obtained in the two cases compared in (2).

4. Tests for the genetic meanings (linkage, pleitropy, selection) of the obtained factors, including experiments aimed at the artificial production of factors by cross-homogamous mating in a population of laboratory animals.

5. Investigation of the inheritance of the speed and uniformity of development of behavioral factors.

By examining these empirical problems with animal subjects, it is hoped that fresh concepts and methods will result that may prove to be useful at the human level. By such a process of "cross-fertilization" we may eventually come to know considerably more than we do now about the inheritance of behavior.

Observations by Dr. J. L. Fuller on genetic factors influencing variability in physiology and behavior, as evidenced by research on animals, are directly relevant to points treated in Professor Thompson's résumé. Dr. Fuller's general comments on the "Relationship of Gene and Character" are followed by some specific "Suggestions about Research Areas."

Relationship of Gene and Character

In addition to the capacity for self-duplication, genes appear to have primary functions of (1) controlling the rates of specific biochemical processes, and (2) producing specific antigens (Wright). Whenever genetic influences upon more complex structures or functions are considered, the gene-character relationship is inevitably remote and may be difficult to analyze. However, steps in this direction are possible with genes having large individual effects. In such situations one can work backward from the fully differentiated character, comparing trait-bearers with non-trait-bearers at earlier and earlier stages of development. Diverse characteristics may thus be found to stem from a

single primary deficiency. Some geneticists (*e.g.* Gruneberg) believe that all cases of pleiotropy are secondary; in other words each gene has only one primary effect upon development.

From studies of variation in inbred animal stocks has come the concept of the genotype as setting the reaction norm, and the related concept of environment as the sum of the agencies which are associated with variation about the mean which is characteristic of a particular genotype. Such a formulation implies that there is a "natural" habitat for each species. We know that environment and genotype interact, so that the same environment may induce more variability in some genotypes than in others. Heterozygosis, for example, seems to favor phenotypic stability (the genetic homeostasis of Dobzhansky and Lerner). Some pure lines of mammals seem to lie close to thresholds which control development, and ordinary amounts of environmental variability induce high polymorphism within these lines (Wright, Runner).

In spite of the fact that behavioral characteristics are notably responsive to environmental influences, experiments with animals under controlled conditions have shown that a great variety of measures of behavior are influenced by genotypes. Some of the reported variables include: activity (measured under several conditions), male sexual activity, nest-building and giving of maternal care, hoarding of food, tendency to defecate when disturbed, susceptibility to audiogenic seizures, amount of fighting, savageness, timidity, maze learning, discrimination learning, delayed response ability, and docility or general trainability. Perhaps it would be safe to say that any two distinct mammalian strains will be found to differ on some behavioral indices, and that a wide enough sampling of different strains will uncover evidence of hereditary effects upon any measure of behavior which can be devised. Many of the differences appear to be polygenically controlled, although simpler mechanisms have been postulated by a few workers.

Similarly, variations in morphology and physiology can be demonstrated to correspond to genotypic variation. This leads to a demand to "explain" hereditary differences in behavior through interpolated structural and functional differences. This is certainly desirable, but it should be clear that the demonstration of the effect of genotype upon behavior and the study of evolutionary consequences of such differences does not depend upon the detailed working out of casual relationships. Working out such relationships may help the physiological psychologist at a theoretical level: it is perhaps essential to the therapist trying to overcome the disadvantages of certain genotypes; but it is not necessary for an evaluation of the consequences of selection upon the genetic constitution of a population. In other words, we need not completely understand the physiology of a deleterious gene combination before considering it as a eugenic problem. However, the way we regard the eugenic problem may be greatly modified when physiological studies enable corrective measures to be taken which alleviate the disadvantages of the gene.

Suggestions about Research Areas

In the area of personality and intelligence, we know that selection of animals for differences in specific learning ability and in specific emotional responses is successful. We do not know what we are selecting in terms of body structure and body chemistry. Recent advances in the fields of endocrinology and neuro-psychology should make possible a direct attack upon the problem. Basic research in this area is apt to be slow, but results will be important. Specific kinds of experiments might include:

1. Comparison of local neurochemistry in strains which differ in behavioral characteristics (Krech, Rosenzweig and Bennett: choline-sterase differences in brains of rats).

2. Comparison of effects of brain ablations in strains differing in behavior (Fuller, Rosvold and Pribram: preliminary evidence in experiments on dogs).

3. Measurement of hormone sensitivity in strains which differ in the strength of activity known to be modifiable by hormones (Young, Riss, Valenstein, and Grunt: sex behavior and hormones in the guinea pig; Fuller, Chambers and Fuller: cortisone and activity in mice).

4. Effects of psychological stress in different strains upon both behavior and physiological functions. Such studies have relationship to the significance of personality differences in the psychosomatic diseases.

5. At a more psychological level, studying the factorial composition of the behavioral differences found to exist between strains. Some preliminary studies have been done at Bar Harbor (Anastasi, Fuller, Scott, and Schmitt), but much more is needed.

The experiments suggested above make use of fully differentiated psychological characteristics. An equally important area of animal research is the evaluation of the importance of different kinds of directive factors at specific stages of development. The time factor, so often stressed in clinical situations, has until recently been neglected in experimental work. Just when does the genotype-environment interaction system become frozen, so that subsequent modification of the organism's characteristics is difficult or impossible? Are there critical periods for channelizing certain functions? Perhaps some of the disputes regarding the constancy of the IQ could be illuminated by properly designed animal experiments in which both heredity and early experience were independently varied.

The possibility of "working backward" in animal research from certain clearly differentiated traits to other developmental processes, comparing trait-bearers with non-trait-bearers at various stages of development, has already been mentioned. This approach has yielded significant clues to the genetic aspects of some deviations in human behavior. But, here too, various possibilities must be examined in making use of new information provided by these studies. The following brief statement summarizes a general discussion of this subject by Dr. Gordon Allen.

Leads from Pathology

In any attempt to study gene action, especially of highly complex traits like behavior, it seems that the only hope is to find a *trail* of effects produced by the gene. This is nicely illustrated in the case of Wilson's Disease, a progressive hereditary degeneration of the brain distinguished by peculiar motor disorders and by hardening of the liver, among other things. The motor disturbance was early related to pathological changes in the basal ganglia of the brain, while the liver changes were thought possibly to represent some specific biochemical deficiency. Subsequently it was found that persons with this disease have large deposits of copper in the brain, liver, and other organs, and that they excrete large quantities in the urine. Most recently it has been learned that these patients have a specific deficiency of ceruloplasmin, a copper-containing protein, in the blood. This is the sort of biochemical defect usually attributed to primary gene action, but in this disease there is still much debate about the primary defect. The *deficiency* of ceruloplasmin (and, hence, of copper) in the blood does not seem to be a sufficient cause of the *excess* copper in the brain and elsewhere, and especially of the high rate of excretion of copper. The ceruloplasmin deficiency may be secondary to some more general intracellular defect in copper metabolism, manifested independently and possibly even more directly in the brain, or the primary defect might be in the digestive tract, which absorbs too much copper.

We can conclude from this example that the discovery of biochemical abnormalities

associated with a hereditary disease does not always bring one closer to the primary site of gene action. However, it usually throws light on the pathological processes involved.

An application of these principles closer to the field of our discussion may be found in schizophrenia. Certain newly studied drugs, such as lysergic acid, produce schizophrenia-like behavior in normal individuals. This has led to the optimistic conclusion that schizophrenia itself may result from the presence of some comparable chemical in the body, and that this may be a primary genetic defect. However, there are at least three other possibilities to keep in mind: first, that the effects of lysergic acid may have only an incidental resemblance to schizophrenia; second, that lysergic acid may produce the same state of physiological unbalance found in schizophrenia but does this by altering an entirely different factor in a complex chemical or physiological equilibrium; and, third, that the disturbance of this equilibrium, though responsible for perpetuation of the abnormal state in the schizophrenic, may itself be only a secondary effect of early pathological reaction patterns, whose etiology is as difficult to explain as any other behavior pattern. Even the last possibility, however, would not exclude a simple genetic etiology.

Another clinical condition that may help us understand the genetic basis of intelligence and brain function is hereditary microcephaly. Evidence has recently been advanced suggesting that the most common type of microcephaly is a simple recessive trait which often shows up in heterozygous carriers in the form of depressed intelligence. This condition seems to deserve much study from two points of view. First, if the heterozygous state impairs intelligence, the anatomical, physiological, and mental effects of the gene should be investigated; much of our present knowledge about brain function has come from this type of study, and in this case a specific gene appears to be responsible. Second, the homozygous state of the gene reduces brain size drastically by what seems to be a sort of compression of the essential component; the resulting brain is a condensed miniature of the normal brain. These brains function remarkably well, with little or no motor disturbance and even some capacity for symbolic mental processes (*e.g.* speech). There has been much speculation about the possible resemblance of these brains to a pre-human ancestor, but little systematic neuro-physiological research on the condition.

In the normal range of intelligence, too, probably much is to be learned about the relation of function to anatomical variations. These variations (especially in microscopic architecture) have received little systematic study, and techniques for counting cells, for example, have only recently been devised. It should be remembered, however, that these variations may be only incidental or even irrelevant to the primary variations in mental capacity, and may not in themselves affect mental function. Monkeys have not just undergone an evolutionary upheaval in their behavior, as has man, and cannot be expected to show a comparable degree of individual variation in intelligence, yet they are said to show similar individual variations in brain micro-anatomy.

In the borderline and moron range of intelligence, some statistical considerations are instructive. The lowest 5 per cent of the population falls below IQ about 75, but the distribution continues to follow the normal frequency curve down as far as about IQ 45. At that point, with about 0.5 per cent of the population remaining, the curve fails to drop off as rapidly as expected. The excess is due to pathological conditions, both genetic and environmental, that are superimposed on the normal distribution. Down to this point, then, most variations appear to be caused by the same factors which produce differences in the normal range of intelligence. Insofar

as this variability may be genetic in origin, the observation indicates that almost everyone carries genes that impair his intelligence, or that would do so in certain combinations. We can probably take this as evidence supporting Muller's contention that deleterious mutations are widespread, and that a large proportion of these are probably concerned with intelligence.

There are three possible explanations for the presence of such deleterious mutations: (1) They may have some compensating selective advantage, either in nonmental traits or in combination with certain other genetic factors for intelligence. (2) They may represent a stage of human evolution we have not altogether left behind us, if civilization has, so to speak, stopped the moving picture while brain evolution is in full progress. (3) They may represent myriad recurring mutations which natural selection, even at top efficiency, could not keep at a much lower level. This again, is a correlate of recent rapid evolution of the human brain, which process would not yet have had time to integrate the changes genetically and develop "stabilizing" genetic mechanisms. The absence of such rapid brain evolution in the recent history of experimental animals probably argues against the comparability of man and animals with respect to individual variations in intelligence. The three influences listed above are not mutually exclusive.

III. General Discussion of Possible Research Leads

1. *Need for new longitudinal studies with attention to factors in intelligence and personality.* Primary behavioral characteristics, as determined by factor analysis, are merely functional entities. They may differ radically in origin. Some may have a genetic basis, whereas others may not.

The most obvious approach to research on the possible genetic significance of such functional entities is the study of their relative constancy among kin of varying degrees in different circumstances. An interesting variant of this approach involves the analytical treatment of the complete, original data for identical twins and for sibs.

Longitudinal studies seem to be particularly important here, in order to investigate the emergence of various factors in intelligence and personality among related and unrelated persons, at successive ages, and under different cultural conditions.

2. *Investigation of apparent pleiotropic changes associated with cognitive and affective behavior.* The possibility of dealing with more specific physiological and clinical components of similar behavior patterns is opening new approaches to the diagnosis and treatment of gross deviations in human behavior.

3. It was recognized that questions about *assortative mating* with respect to various mental and personality traits have a direct bearing on the type of eugenic theory that finds favor in the American Eugenics Society today. If intelligence and personality are highly multifactorial in their biological as well as in their social conditions, it is important to study the extent to which there may, or may not, be any association among the various genetic factors. In other words, do some individuals have "clusters" of genetic traits that provide better adaption to the broad requirements of our society than the corresponding "clusters" of some other people and is there any tendency for such clusters of traits to hang together, or to be reassembled, in successive generations?

Assortative mating is the primary mechanism by which such clusters of associated traits, diverse in nature and origin but similar or congenial in effect, can be built up and maintained within a large, continuing, and heterogeneous population. This is a subject on which there has been relatively little research in comparison with its theoretical importance.

IV. Recommendations

The Committee believes that the relatively neglected and very complex field we have traversed in our discussion should be explored more systematically.

The Committee therefore recommends that the American Eugenics Society initiate arrangements for a seminar, or series of seminars, to be concerned with reviewing the conceptual framework of research in this field.

Again, a continuing committee in this field would be able to give more detailed consideration to specific research needs and possibilities. It might eventually formulate concrete plans for research that would merit serious consideration. It recommends that the Society consider possible ways of promoting the continuous and systematic consideration of new possibilities of significant research in this area.

Frank Lorimer
Chairman

FERTILITY CONTROL IN THE LIGHT OF SOME RECENT CATHOLIC STATEMENTS

*This is Part Two of a two part article.**

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The secondary ends of marriage cannot be ignored or disparaged without detriment to doctrinal integrity. To do so would be to revive the errors of the Montanists and others whom the Church Fathers found it necessary to condemn. Rather, the true Catholic position is one of delicate balance between the two extremes. Pius XII, in his address to the Sacred Roman Rota (high ecclesiastical court) on October 3, 1941, expressed the matter thus:

> Two tendencies are to be avoided; first, the tendency which, in examining the elements which constitute the act of generation, consider only the primary purpose of matrimony, as though the secondary purpose did not exist, or at any rate were not a *finis operis* [essential purpose] established by the Creator of Nature itself; secondly, the tendency to regard the secondary purpose as equally important, and to divorce it from its essential subordination to the primary purpose. . . . In other words, if truth stands in the middle, two excesses are to be avoided: on the one hand, practically to deny or unduly to depreciate the secondary purpose of matrimony and of the act of generation; on the other, to dissociate or separate unduly the conjugal act from the primary purpose for which, by the whole of its intrinsic structure, it is primarily and principally intended.[31]

Catholic leadership, then, is not unaware that in opposing the tendency to exalt unduly the secondary ends of marriage there lurks a danger some may go to the opposite extreme by undervaluing these ends. If at this time, great insistence is laid on the absolute primacy of the procreative purpose of sex, it is because so many are losing sight of the essential ordering of ends, and of acts in relation to these ends, in accordance with the nature of man.

While thus insisting on the primary end of marriage as deriving from nature itself, the Catholic position recognizes that in the concrete this is not always the end uppermost in the minds of those marrying or making use of marriage. Their immediate intent may be otherwise: the expression or fostering of mutual love, the relieving of concupiscence, the avoiding of irregular relations or perhaps personal unchastity.[32] These are all legitimate purposes, the pursuit of which does not in itself imply any deliberate exclusion of the primary end. This fact the Church has long recognized, permitting and blessing the marriages of those incapable of reproducing because of age, or for some other reason, provided they are able to perform the sex act in a natural manner. The objective finality of marriage is preserved so long as the spouses take no positive action to exclude the primary end and hence refrain from interference with the processes

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[31]Cf. *Clergy Review* 22:84-8, February, 1942, for English translation. Italian text in *Acta Apostolicae Sedis*, 33 (1941) 421-6.

[32]For more extended discussion of the ordering among themselves of the ends of marriage, see E. C. Messenger, *Two in One Flesh*. Westminster, Md., Newman Press, [1948] Vol. III, ch.22, p.162-80. The author gives numerous references to the Fathers, theologians, and Roman documents.

of nature.[33]

Accordingly, not only may sterile and over-age persons marry, but those who are fertile may use marriage on days when the woman is known to be sterile.[34] Furthermore, for sufficient reason they may restrict the use of marriage to such days in anticipation that conception is less likely or unlikely to result. Their reasons should not be trivial, frivolous, or purely selfish, but significant, for example of a medical, eugenic, economic or social character.[35]

Nevertheless, because the primary end given by nature is of such preeminence, it would be wrong to enter marriage, except for good reasons, on the understanding relations would always be confined to sterile periods. Were a condition attached to the marriage contract to the effect mutual rights were exchanged *only* for sterile periods, then the marriage itself would be invalid.[36] This is not to say that any particular marriage must be productive of a given number of children, but rather that if marriage is used it may only be with due regard for the essential order of nature. This order cannot be changed or modified by the will of the spouses. Nor may the Church herself change it. It is not a question here of ecclesiastical discipline or of manmade law susceptible of change, but of natural law which the Church defends but does not create.

This may appear as metaphysical hair-splitting to some less accustomed to distinguish sharply between essential finality and subjective purpose, between intent and effect, between means and end. But Catholic teaching regards it of major consequence and a point not to be overlooked without threat to morality on a number of fronts, and not merely that of fertility regulation by the married.

Objectively, then, there is a qualitative difference between the limiting of family size by artificial contraception in its various forms, and the reducing chances of fertility simply by refraining from use of marriage on days when conception is likely to occur. In the former case man upsets the order of nature while achieving sexual satisfaction; in the latter he preserves this order, other things being equal, and must forego satisfaction to do so. In either case the number of children born to a marriage may be the same. In fact, the users of artificial contraception may actually plan and achieve a larger number of offspring than the spouses using natural means of regulation. But this is beside the point when it comes to appraising the inherent goodness or badness of means. The morality of individual sex acts derives from their being ordered according to nature, not in their occurring within a marriage which de facto achieves a given number of children.

III. Disapproved Methods of Fertility Regulation

From the foregoing it should be clear that any method of fertility regulation is regarded as morally wrong in Catholic teaching, if it runs counter to the processes of nature and natural function.[37] Control of family size can of course be achieved by infanticide, namely the killing or exposure of an infant *after* birth. Suffice to say this would be objectively murder, whatever the motivation, and generally is regarded as

[33]It is basically in the direct interference with these processes, in the wilful distortion or perversion of a natural function, that the wrongness of contraception is to be found. Similarly, with other acts of unchastity, whether alone or with others. This is an important point which has a definite bearing on current proposals for the physiological control of fertility.

[34]Cf. Pius XI, *Casti Connubii*, no. 60. *Acta Apostolicae Sedis* 22 (1930) 561.

[35]Address to the Midwives, no. 36.

[36]*Ibid.*, nos. 32-33.

[37]In his *Standing Room Only* (Beacon Press, 1955) Karl Sax seems to imply that the Church's objection to artificial control of fertility is directed solely against mechanical and chemical contraceptives. The sentence he quotes (p. 184) happens to refer to precisely this kind of contraception. In the original text the paragraph ends with the more general principle: "Rather the moral prohibition extends to each individual use of artificial means designed to frustrate the natural purpose of the act." (Cf. Gibbons, *op. cit.*, p. 119.)

such by civilized peoples. It is not the issue here. Prior to birth the processes of nature can be interfered with either before or after conception has occurred. If it is the latter, then in addition to the interference with natural process there is also a question of destruction of life which came into existence with conception. Catholic moral teaching takes a position on each of these procedures; this will be indicated in what follows.

Abortion, or the artificial interruption of pregnancy as it is sometimes called, involves the deliberate and direct destruction of human life. If however, the death of the fetus is indirect, *i.e.,* merely permitted as an unfortunate and incidental outcome of an immediately necessary operation such as removal of a diseased uterus, then it does not fall within the scope of our discussion. Catholic moralists would readily admit this is not a case of direct attack on innocent life nor the destruction of life as a means to an ulterior objective. It is precisely when the killing of unborn life is used *as a means* to another end: avoidance of a possibly dangerous childbirth, or limitation of family size, that objection is raised. Such an act is regarded as always and everywhere immoral, and from the nature of the case seriously so.[38] Put briefly, Catholic teaching says it is murder.

Nor may public authorities undertake or legitimize such destruction of fetal life on the grounds the social welfare and the common good demand it. The unborn child is neither a criminal who has forfeited his life to society, nor an aggressor against which society must defend itself. He is an innocent individual whose very existence is not of personal choice, but the outcome of someone else's action. In this connection it may not be inappropriate to recall a reply of the Holy Office dated December 2, 1940. Asked about the morality of putting to death innocent persons under the Nazi regime, the answer given was that such action is illicit and against the natural law.[39] That the immediate occasion of the query was the extermination of psychic and physical defectives does not affect the principal involved, namely that the state cannot authorize the destruction of persons simply on the ground that they are superfluous, burdensome, or an obstacle to national vigor. The principle applies to fetal life as well as those already born.[40]

Subsequent to his 1951 addresses on marriage, Pius XII was severely criticized in some quarters for what was portrayed as his favoring of the life of the child over that of the mother. Actually, he was proposing no such choice but merely pointing out the traditional Catholic teaching that the death of the unborn child cannot be effected in order to achieve some other good, individual or social. In this instance, as also in the case of the ends of marriage, the Church merely was applying and defending the law of nature and hence of God. It had no choice but to act as it did.[41]

The argument has been advanced by some that since human life is not present during the first stages of gestation, to evacuate the embryo at an early stage, or to prevent implantation or development of the fertilized ovum, is not abortion but at most contraception.[42] On the speculative level this is nothing but a revival of old theories on successive forms (vegetative, animal, rational) which are said to animate the embryo and fetus prior to birth.

[38]Cf. *Casti Connubii,* no. 64 ff.

[39]*Acta Apostolicae Sedis,* 32 (1940) 553. English translation: Bouscaren, *op. cit.,* II, p. 96-7. Pius XII makes explicit reference to this decree in the address to the midwives, no. 12.

[40]Address to the Midwives, no. 12.

[41]Cf. Huerth, *Litterae Encyclicae: De Matrimonio Christiano Rome,* Gregorian Univ. Press, 1953. p. 105; Huerth, *De Re Matrimoniali,* p. 84 ff. Both these discussions are in Latin. For a commentary in French, cf. S. de Lestapis, *Les Vraies Valeurs de la Vie Conjugale* (Discours de S.S. Pie XII aux Sages-femmes). Paris, Editions Spes, 1953; also *L'Encyclique Casti Connubii.* Paris, Editions Spes, 1955.

[42]Thus seemingly P. S. Henshaw, *Adaptive Human Fertility.* McGraw-Hill, 1955.

According to this theory, only in the last stage (rational soul) would a man strictly speaking be regarded as present. Whatever the speculative merits of such a position, in practice it cannot be accepted. For strong arguments from both metaphysics and empirical science exist to indicate human life is present from conception, so that to proceed as if it were not there when it presumably is, would be equivalently murder. It is noteworthy that Pius XII in his 1951 address makes no distinction as to length of time from conception, but says that any attempt to dispose of unborn life is a violation of the commandment: Thou shalt not kill.[43]

But quite apart from the presence of human life and the consequent right to life, is a fact that abortion at any stage constitutes a perversion of human reproductive function and hence is sinful, more so than simple contraception since it is a matter of arbitrarily disposing not merely of semen but of embryonic life already in process of development. Hence, on this score as well as by reason of the attack on human life, prevention of development (contragestation) and hindering of implantation (contranidation) are completely unacceptable in Catholic morality.[44]

If abortion is wrong, so too is *sterilization* as a means of contraception. It achieves its objective, the regulation or rather prevention of fertility, by mutilating the body and perverting a natural function. That the mutilation today is slight, especially in the case of the male, and is neither debilitating nor outwardly discernible, does not affect the essential morality. The wrongness springs not from the gravity of the operation or its painfulness, but from the wilful destruction of a natural function, not for immediate benefit of the whole body, but as a way of permitting sexual indulgence without acceptance of consequences ordained by nature. The Catholic position is, and will remain, that the voluntary acceptance of sterilization, the act of sterilizing, and the promotion of sterilization as a method of fertility regulation, are all morally unacceptable, and that no public authority or legislation can make them right.[45]

What is said of permanent sterilization, applies also to temporary sterilization by whatever means induced. Asked whether the direct sterilization of man or woman, whether permanent or temporary, is licit, the Holy Office replied on February 24, 1940: "It is forbidden by the law of nature, and, as regards eugenic sterilization it has already been condemned in the decree of this Sacred Congregation, of 21 March, 1931."[46] The mention of temporary sterilization is significant in the light of some recent proposals for using drugs ("the pill") to regulate fertility by preventing ovulation or otherwise forestalling conception by physiologic means. Except in the case where drugs were used merely to regularize the female period, so that it did not come at abnormal times, the procedure proposed can be judged as nothing but a form of temporary sterilization whose morality must be judged accordingly.

Contraception is sometimes taken to include all means of regulating fertility, including "rhythm," resorted to prior to conception. It has already been pointed out above that from the viewpoint of effect there are similarities between the rhythm and other means, but that in the light of method there is a qualitative difference which affects the morality. Here we do not include the use of periodic continence in what is said of contraception.

Any means adopted to prevent the semen from reaching the ovum comes under the general heading, contraception. This ob-

[43]Address to the Midwives, no. 12; *Casti Connubii*, no. 64.

[44]For a more detailed discussion of this subject, see J. J. Lynch, "Fertility Control and Moral Law" and "Another Aspect of Fertility Control" *Linacre Quarterly*, 20 (1953) 83-8; 118-22.

[45]Cf. *Casti Connubii*, no. 70 ff. See also Huerth, *De Re Matrimoniali*, p. 104-9.

[46]*Acta Apostolicae Sedis*, 32 (1940) 73; Bouscaren, *op, cit.*, II, p. 96.

viously differs from means taken after fertilization to prevent the development or birth of the life which has come into existence. Contraception does not imply the sort of interference with life that is intrinsic to abortion, or to contragestation and contranidation. But it is a perversion of natural function, according to Catholic teaching.[47] As such it is morally reprehensible and cannot be approved as a means of fertility regulation.

Contraception is usually taken to imply some interference with the natural act of intercourse, whether by withdrawal, by only partial penetration, or by the placing of a mechanical or chemical obstacle which prevents the semen from reaching the uterus and Fallopian tubes, at least in a live state. Some have argued that an oral contraceptive (the pill) would be qualitatively different as regards morality, since it implies no direct interference with the sex act performed naturally. Now whether this particular form of fertility regulation is properly called contraception is open to question. But one thing is certain, its intent is contraceptive (as is the case with sterilization), and it is in fact temporary sterilization. As indicated above, it is morally unacceptable for that reason if for no other.[48]

There is a positive kind of fertility regulation about which something should be said, namely the use of *artificial insemination* to induce conception when this seems otherwise unlikely to occur.[49] If it implies merely utilizing some mechanical or other means to facilitate the passage of semen into the uterus when intercourse has taken place in the normal manner between spouses, then it may be permissible. If, however, it means procuring the semen from the husband apart from intercourse, then it is illicit. Should the semen come from another than the husband (donor), then there is also question of violation of marital fidelity. That children are the normal outcome of marriage, and procreation is a primary end, does not change the principle that fertility should result from natural process and not by acts which are disordered.[50] Pius XII has put the matter thus: "To reduce cohabitation and the conjugal act to a simple organic function for the transmission of seed would be converting the home, the sanctuary of the family, into a mere biological laboratory."[51] Hence, even when fertility regulation means planning for children, it can only be by natural processes, associated with normal intercourse between spouses.

Conclusions

Catholic moral teaching rules out absolutely as means of fertility regulation any suppression of life once conception has taken place, whether this be by abortion, contragestation, or contranidation. These are regarded not only as perversions of natural function but also as unjustified taking of human life.

Prior to conception, any mechanical, chemical or other means is illicit which has as its objective the prevention of conception by keeping semen from reaching the ovum, interfering with the natural process for this purpose.

Sterilization, whether permanent or temporary, and whether induced by surgical, physiological or other means, is unlawful when directly intended as contraceptive in purpose.

There remains, then, as an acceptable

[47] *Casti Connubii*, no. 55 Address to Midwives, no. 24.

[48] Cf. Address to Midwives, no. 27.

[49] Cf. Gerald Kelly, "The Teaching of Pope Pius XII on Artificial Insemination." *Linacre Quarterly*, 23 (1956) 5-17; Henry Davis, *Artificial Human Fecundation*. London, Sheed & Ward, 1951.

[50] Cf. Pius XII, Address of September 29, 1949 to the Fouth International Congress of Catholic Doctors. *Acta Apostolicae Sedis* 41 (1949) 557-61 (French text). Major portion of address in English translation, Bouscaren, *op. cit.*, III, p. 432. Cf. Address to the Midwives, no. 51. See also address of May 19, 1956 to Second World Congress on Fertility and Sterility; report excerpts to New York *Times*, May 20, 1956.

[51] Address to the Midwives, no. 51.

means of fertility regulation only abstinence, either permanent or temporary. This latter, in the presence of sufficient reason, is certainly acceptable morally; its effectiveness will of course depend on the technical efficiency of means for detecting approaching ovulation, and on the self discipline of the marriage partner.

HEREDITY AND ENVIRONMENT REEXPLORED
Specification of Environments and Genetic Transmission*

LEWIS A. DEXTER

GENETICISTS NOWADAYS GENERALLY accept in principle some such formulation as the following: "A trait is an abstraction. . . . What is actually inherited is a dynamic pattern of developmental processes which directs the course of the body. . . . Development at any stage is a function of the environment in which the process has taken place." (1)

But the *application* of this approach to such psychogenic phenomena as schizophrenia, mental deficiency, neurosis, accident-proneness, and allergy is very unusual. Geneticists mislead non-technical readers by falling back on such phrases as "The Inheritance of Personality" to quote the title of a recent article in the *American Journal of Human Genetics,* (2) which then goes ahead to discuss the so-called "inheritance of neurosis"; and of course we are all familiar with attempts to trace the pedigrees of schizophrenics (4) and mental defectives (5) and draw rather sweeping conclusions from them.[1] There is every reason to trace such pedigrees, but reason also to express caution in drawing conclusions from them.

The difficulty we face is that we have only vague and general bases for specifying the "existing variety of environments." There is therefore a strong tendency to omit from consideration any specification of environments at all; and this is particularly true when we come to the distinctively social aspects of environment. Sociologists have been concerned particularly with the identification of "culture" and of "primary group" constellations[2] as determinants of behavior. They customarily use these factors to "explain" psychosis, neurosis (7), criminal tendencies, and sometimes psychosomatic disorders, and personality traits such as genius, mental defect, and the like. Freud, Charles Horton Cooley, William Graham Sumner, Ruth Benedict, A. Kardiner: these names indicate the sociological explanations referred to.[3]

To be sure, most sociologists, if pressed, would admit that "constitutional" and "genetic factors" may play a part; and presumably, if pressed, most geneticists would admit "sociological" factors may play a part. But the clinician or student who reads one group of writings will find their "explanations" of the phenomena almost unconnected with the "explanations" advanced by the other. Students in medical genetics might be taught a "hereditary" explanation of schizophrenia or mental defect, which would be pooh-poohed in another course or school where maternal overprotection or social isolation would be

*This paper was prepared under a grant from the Estate of K. J. Anthony of Lewiston, Maine, "to be used for the benefit of those of God's Children known as the feeble-minded." It was read at the meeting of the American Society of Human Genetics, East Lansing, Michigan, September 1955.

[1] I may add that a distinguished geneticist, prominent in the American Society of Human Genetics, perfectly seriously proposed as late as 1951 that historians take census records for 1850 for a particular state and collaborate with psychologists in estimating the intelligence of those recorded in the records, whereupon geneticists would trace the pedigrees. As late as 1940, a distinguished geneticist published a book in which he indicated that the differential fertility of the mentally deficient was an importance factor in leading to deficit spending upon the Keynesian model. For this and other somewhat similar assertions see (3).

[2] I use the term "constellation" here in lieu of the more conventional "interaction" for methodological reasons indicated in (6).

[3] During the last ten years the "culture-and-personality" school has attempted to integrate the culture and primary group constellation approaches. See (8), (9).

regarded as the etiologically significant factor.

Basically, the need is for a rigorous specification of environments. No such specification is offered here, for the task is too large for the present occasion, but some suggestions are made which are useful in working toward such specification.

1. Sociologists generally, I judge, tend to feel that "genetic" explanations have a racist or aristocratic taint attached. Myrdal in the book which has probably been more influential than any other single sociological treatise of the last fifteen years says: "It is hardly possible to be a true biological determinist and yet a political liberal,"[4] and most sociologists have read or misread writings by geneticists as implying biological determinism. Pastore (11) in a rather careful study has in fact shown that among American scholars genetic explanations are more apt to be correlated with "conservative" or "reactionary" political views and sociological ones with "liberal" or "radical" views. (10) Of course if this is true, it has nothing to do with the merits of analysis, report or experiment, provided that we content ourselves with exploration on the scientific level, and distinguish that sharply from political and social inferences. Nevertheless, advocates of genetic determination have this obstacle to overcome in being accepted—nowadays one might almost say against being heeded—by social scientists. Hitler is still working in mysterious ways to influence human affairs, and this is an example.

2. Both geneticists and social scientists need consistently to talk and write as though they took seriously this proposition (unless of course at some time it is disproved): "We cannot predict what phenotype a given zygote will develop into unless we know something about the environment in which it is to develop."

3. If such a statement is accepted, then we need to specify environments as carefully as we can. Now the great difficulty with genetic studies as contrasted with social scientists' level of observation is that geneticists and clinicians are observing and reporting on the level of development of individuals organisms when studying such phenomena as mental defect; whereas social scientists frequently talk about "culture" and "social environment" in gross, general, average, statistical terms applying to populations. "Culture" does not as such directly affect a person; the person is brought up in a particular environment, and in the present state of sociology it is difficult to find sociological literature which carefully indicates the level of abstraction used in describing environments.

4. A good deal of writing on genetics—and much clinical genetics—is of course concerned with predicting the risk involved in certain kinds of matings. But so far as the more complex and difficult-to-observe psychological factors are concerned, when we introduce the phrase "the environments remaining constant," we really—in the present state of our knowledge—throw out much possibility of making any long-range prediction. Capable sociologists, psychiatrists, and psychologists maintain that a good many psychoses or neuroses develop because of the stress of environmental factor, as a result, for example, of the inability to reconcile conflicting role or status demands, and that these psychoses or neuroses are in a sense "adaptive," viz., they are said to be means of reconciling or evading the conflicts involved in the situation. If this be so, then the issue is to determine which human organisms, granted the presence of equally conflicting status or role demands, will find psychosis or neurosis "adaptive" and which ones will not. Now this means that we have first to develop a criterion for "measuring" role conflict *which is independent of the psychosis or neurosis.* For, in fact, the environment of the person who is suffering from a severe role conflict is different from the

[4]Contemporary sociologists are usually "political liberals." See (10).

environment of the person who is not. If we take a pedigree where several persons appear to have suffered from psychoses of one sort or another, we have to rule out the likelihood that all these persons suffered from such role conflicts, for instance, before we can make any reasonable prediction about the risk that their descendants will experience similar psychoses or we have to show their descendants are equally likely to experience such role conflicts; or alternatively we have to show some aspect of constitutional development which makes persons far more prone to find psychosis or neurosis adaptive than others with equally great role conflicts.

Let us give a few examples of the difficulty of segregating the effect of environment on all the members of a kinship group from the effect of possible genetic transmission. There is nothing new in the point that it is difficult to distinguish the effect of "heredity" from that of "environment" on the individual; but less has been done than we might wish in exploring the possibility of differentiating the effect of "culture" or "social status" upon groups of related individuals from that of genetic transmission. Suppose, for example, the family in question is Jewish. There are fairly obvious reasons why recent generations of Jews—as a result of breaking away from the Ghetto, as a result of the high degree of social mobility in many Jewish families, and of what we cay call "conscientiousness" instilled in many Jewish children in early familial training, and finally as a result of the covert and overt manifestations of prejudice many Jews are exposed to—might have produced more persons suffering from role-status conflicts, who find neurosis or psychosis adaptive that would recent generations of, say, French-Canadians. I have no idea whether Jews do differ statistically from French-Canadians in this respect, and because of the absence of trustworthy statistics on any of these matters, neither has anybody else. The point is merely that the social environment of Jewish professional men in, say, New England, has been different from that of a French-Canadian family in Quebec, but—and this is crucial—differences which have existed in the past between these groups may, and probably, will, diminish in the future; discrimination against Jews in this country appears to be less destructive in its psychological consequences than it used to be, and more Canadians are breaking away in adolescence or adulthood from a group and family system of values (or so it is alleged by the French-language press of New England). So the environments are not constant and prediction rests upon very dubious ground.

Or take "mental deficiency," particularly the 80 per cent of the so-called "familial" mental deficients, who show no clear constitutional differentiation for the rest of the population, except that they are mentally deficient. (Persons with visibly defective nervous systems, or those with rather rare constitutional conditions, which can be recognized fairly readily, such as phenylpyruvic amentia, fall into a different category.)

How do we identify high-grade mental defect? By determining in effect the degree of aptitude persons show for performing certain types of operations. Generally, the operations which they are asked to perform consist of "intelligence tests" of one sort or another. We know that "culture," "social status" and "motivation" all play a considerable part in determining the seriousness with which such tests are taken, and the degree of ability shown in manipulating them. Unless we succeed in specifying that culture and social status and motivation have not entered into the grading of test results, we can not arrive at any very solid genetic conclusions.

An additional point should be made here. Frequently, we can quite usefully predict what persons will do in one situation on the basis of their skill or behavior in another; motivation in an individual personality has a tendency to remain con-

stant in a wide range of situations and few personalities completely revise their "definitions of situations" once these are acquired, even though the external social "reality" may change considerably. Consequently, intelligence tests or other tests of intellectual aptitude may be "true," that is, have an extremely high predictive value, for an individual without necessarily having any bearing on the transmission of developmental potentialities from one generation to another.

Naturally, clinical psychologists are trying to develop better instruments for the identification of "true" mental defect[5] and the measurement of intelligence generally. But no matter how valid the instruments which may be developed, all they can show is that persons with a certain developmental potentiality, genetically acquired, can develop into what we call "mental defectives," *under certain environmental conditions,* and that the problem is to specify the environmental conditions under which such development is (or is not) likely.

5. This means that we have to develop a series of hypotheses which, directly or indirectly, can be tested about environment and development. The practical difficulty is, of course, that we do not have available to us the kind of controls which laboratory conditions, for example, permit so that we can quickly and readily specify the full total of relevant environmental conditions. No doubt one reason we have failed to formulate useful principles about development is precisely the difficulty suggested; but the fact that we have not been able to resolve these is no excuse for not specifying what we don't know. For if we fail to specify what we don't know, and just take it for granted, there's a tendency to forget that we don't know it, and characteristically to formulate principles and laws which give no indication of our underlying ignorance. Whereas if we keep on obstinately trying to formulate what we don't know, we may discover a way of getting around the difficulties.

One favorite method of present-day geneticists for exploring the problems here referred to is the study of twins. Quite likely, such study may throw light on important issues of genetics and development; but in view of present-day failures to specify, it does not have great value for the study of psychogenic conditions like mental deficiency, schizophrenia, or related disturbances. First, no study of twins to my knowledge suggests that some of the co-twins studied were placed in quite different cultures or subcultures from the other member of the pair. The presumption in most cases is that, although in some reported instances, the twins studied were brought up at somewhat different socioeconomic levels, they were brought up within the same general culture, (12) with the same general practices in regard to weaning, toilet training, classroom frustrations, and so forth. Now the significance for our purposes of sociological theory or of psychoanalytic theory is that these practices are crucial in determining how the personality develops; *e.g.,* a person exposed to the certain deprivational practices in weaning, toilet training, or schooling is likely to develop the same deficiencies in motivation or intellectual skill as another person exposed to the same deprivational practices. This is the meaning of the use of "complex" and "type" in psychoanalytic and personality theory.

If this is true, it is probably true only if the persons in question have similar constitutional predispositions to begin with, for example, if their kinaesthetic responses resemble each others'. But twins do have such resemblances, so the fact that they are brought up apart, in the "same" culture, does not really enable us to segregate "hereditary" from "environmental" factors in the developmental processes which may

[5]A particularly promising attempt in this direction is the Family and Health Study at the University of Delaware under the direction of Joseph Jastak.

lead to states defined as "psychosis" or "mental deficiency."

On the other hand, studies of culture differences, so far as I know, fail to take into account that co-twins reared apart often *may* have a social environment more similar to each other than co-twins reared together. This arises out of the following set of circumstances: any set of like persons living or working together tend to develop some specialization of role. Observers have reported this as characteristic of twins; one becomes "the ambassador" to the outside world, the specialist in social relations, for instance, and the other does not. Such specialization is in fact an almost inevitable consequence of the latent competition for the same attention, space, etc. between twins.

Twins reared apart, however, face no alternatives of specialization and differentiation on the one hand or competition on the other. If, as is more often than not the case, they are brought up in the same general socio-economic level by much the same sort of people, it can be anticipated that because of their constitutional similarities their development may be very much alike. One reason for such development is the role appearance and constitution play in social development; red-haired people in many environments will respond, either positively or negatively, to the social expectations about red hair. But red-haired twins may find it difficult or impossible for both of them to develop the quick temper, for instance, characteristically expected of the red-haired, if they live together; and in any case, being twins will be a dominant social experience for them. Reared apart, they may both respond similarly to the characteristic social expectations in our society about red-haired people.

Of course, if one twin is brought up as the youngest of a large family of foster-siblings and the other is brought up as an only child, one might expect differences to develop; but so far as I know observations and experiments in the field have not been focused on such factors which constitute such "real" differences in the social environment. And, obviously, if a red-haired twin of Angle-American ancestry were to be brought up in rural Japan by Japanese foster-parents, social expectations about red hair would be far less significant than other visible differences between that person and other persons in his environment.

None of this is to assert firmly that mental defect or schizophrenia may not be well explained in terms of genetic transmission. It is merely to assert firmly that no one at present knows whether this is the case or not; because no specification of environments adequate for the purposes of analysis and observation has as yet been developed. For example, some of the familial "mentally defective" might in fact be so almost entirely because of certain factors in weaning, toilet training, etc., *combined* with exposure to the educational experiments and skill of our society. (13) If the educational techniques and requirements to which they are subjected were modified in terms of their aptitudes, (14) (15) it could conceivably turn out that a large part of what we now call "mental deficiency" would not become developmentally manifest. In the "mental hygiene" area many practitioners preach a similar premise, and sociological rather than rational reasons explain why we regard "mental defect" as more inherent and therefore less modifiable than psychosis or neurosis.[6]

Present-day knowledge can be used to support unfamiliar and seemingly bizarre conclusions such as that just stated, just as Woodworth used present-day knowledge

[6]The major social reason appears to be this: Psychosis has been of considerable, and neurosis of great, interest to social scientists during the last twenty years, and they have applied their newly acquired insights to these fields. But there has been a continuous disinterest, if not resistance, by social scientists in consideration of mental defect, and this field therefore has not changed theoretically since 1935.

(for we know little more about the topic than we did twenty years ago) to report: "On the strength of some . . . findings, the suggestion has been made (impliedly by qualified psychologists) that society, instead of seeking to minimize the fecundity of feeble-minded women, should utilize them as breeders of children for adoption into high-level homes.[7]

We can more freely do one thing, however, which was not possible much before Woodworth made the report to the Social Science Research Council just cited. We can break down the almost unanalyzed conception "social environment" which he employed into a series of suggestions for specific observation about actual behaviors.[8]

Since my concern here is in the social science field, I have discussed the specification of social environments, but a similar specification of physical environments may be necessary. We know of course that under certain conditions, the biochemical and physical environment of the embryo can make an enormous difference in the development of mental defect; and that probably severity of certain disease in infancy can also materially affect the nervous system. But it is not inconceivable that other, less obvious differences, in climate, presence of industrial wastes, and so forth, may also modify the development of developmental potentialities; and in any case, simply because we do not believe that such factors will make a difference, is no reason for refusing to consider them.

[7]See (12) footnote 15.

[8]The entire literature of the personality-and-culture movements, probably the most popular current field of social psychology, supports this statement.

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THE HEREDITARY ABILITIES STUDY

The University of Michigan*

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In recent years important advances have been made in many areas in genetics, but there has been no large scale interdisciplinary investigation of twins since Newman, Freeman and Holzinger's work in the thirties at the University of Chicago. Marked progress has also been made since that time in the theory and practice of psychological measurement and anthropometry, while a whole new area in biochemistry has opened up: the paper-chromatographic assay of amino acid excretion. In 1952 the Institute of Human Biology of the University of Michigan received a grant from McGregor Fund of Detroit to undertake a study of the relative similarity of identical and fraternal twins on wide samples of anthropometric, biochemical psychological variables. Data analysis has been supported since July 1955 by a U. S. Public Health Service grant. We chose to study a large number of variables, rather than to concentrate on a few traits previously reported to be under hereditary control.

This decision was based on the fact that the main usefulness of comparing identical and fraternal twins lies in the detection of traits which are under hereditary control. To work out the exact mode of inheritance other methods have to be used, such as, for instance, studies of pedigrees. On the other hand such studies cannot be undertaken until reasonably accurate ways have been worked out to measure the trait one wishes to study.

A total of 45 pairs of identical twins and 37 pairs of fraternal twins finished the complete battery of examinations used in this study. We are extremely grateful to these young men and women for their cooperation.

(Data collecting was discontinued after April 1955 after preliminary calculations had indicated that the addition of further pairs was not likely to change the nature of the conclusions which could be made from the results for the 82 pairs examined.)

With the exception of three pairs of undergraduate students from the University of Michigan, the twins came from junior and senior high schools in Ann Arbor, Ypsilanti, Dearborn and Detroit. A great deal of credit is due to the school officials who made the names of twins available, and permitted the use of school facilities and school time.

The majority of the twins were between 16 and 18 years of age. In several of the schools all the like-sexed twins were seen. To allow a meaningful comparison, no boy-girl twin pairs were used in this study. It is possible that a few fraternal twin pairs were overlooked in some of the large high schools in Detroit. This would in general lead to an underestimate of genetic control because these overlooked twins would tend to be particularly dissimilar fraternal twins.

After the twins were located, a field worker visited their home to secure their cooperation and to interview the parents. The most important question asked by her

*This investigation was supported in part by a research grant M 1045 from the National Institute of Mental Health of the National Institutes of Health, Public Health Service.

was whether there had been any events which which would lead to dissimilarity between the twins, such as major illness or separation for a significant length of time.

In this interview we were also interested in securing information about the socioeconomic status of the parents of the twins because of the reported relationships between intelligence and socioeconomic variables.

After the parental interview arrangements were made for the twins to come to Ann Arbor for two days. In addition arrangements were made to administer eight hours of paper-and-pencil tests in the high schools in which the twins were enrolled.

During the visits to Ann Arbor the twins were given a complete anthropometric examination by Philip J. Clark. The anthropometric measures collected include height, weight, length and circumference of extremities, handgrip strength, speech recordings, hair samples and black and white photographs of the head in profile and in face, the hands and ears as well as color photographs of the iris of both eyes.[1]

The biochemical data obtained by H. Eldon Sutton include the level of a number of amino acids in the blood, urine and saliva, from which can be calculated the rates of renal absorption of some of these substances.

The first urine sample was collected upon arrival at the laboratory while the two additional samples were first morning samples. The field worker collected these on certain days by going to a number of homes of twins.

The psychological measures collected by Steven G. Vandenberg include, besides the paper-and-pencil tests given in the school, a number of tests administered individually in the laboratory. For some details on these measures see below. Valuable advice on the selection of psychological tests was given by the late L. L. Thurstone and R. B. Cattell, both of whom had conducted studies of the heritability of mental traits before our study was started. (2)

In addition several other traits and characteristics were examined. Sibley W. Hoobler of the Cardiovascular Unit of the University Hospital arranged for an examination, during which an extensive set of measures of cardiovascular function was collected. The twins were also seen by Harold F. Falls of the Ophthalmology Clinic who gave the twins a detailed examination, including a refraction.

Each twin pair visited the Orthodontics Department of the Dental School where Robert E. Moyers had made arrangements for a careful examination by James P. Alderisio who made dental casts and frontal and lateral head X-rays as well as X-rays of the hands.

Before reporting any findings it may be useful to review briefly the rationale of twin study method.

By comparing the average within-pair differences of identical twins with the average within-pair differences of fraternal twin pairs, it is possible to obtain an estimate of the importance of heredity in the determination of a trait. The proportion of the variance attributable to genetic factors has been called heritability.

Differences between identical twins can only be due to non-genetic (*i.e.*, environmental) factors, because identical twins have identical genetic makeup. Some of the better known non-genetic factors are differences in diet, differences in the parental treatment of the two twins, illness of one twin only. There may be others. Fraternal twins are subject to the same difference producing influences. In addition they differ considerably in their genetic makeup. Therefore, fraternal twins will be more dissimilar than identical twins on traits which are under genetic control. Without burdening the reader with the details of the statistical procedures used in

[1]For a full list of anthropometric variables see (1).

practice, we can say that the discrepancy between the two sets of differences for any specific trait will constitute an indication of the degree of genetic control over that trait.

Implicit in this argument are at least two important assumptions. First of all it is assumed that non-genetic factors will tend to lead to greater differences in fraternal pairs than in identicals or, in other words, that identicals will not be exposed to more similar non-genetic environments. It may well be that identical twins are treated more alike than are fraternals. This would lead to an overestimate of the importance of heredity. On the other hand, it is also possible that there are non-genetic factors which affect only identical twins.

Price (3) has reviewed evidence on prenatal conditions and came to the conclusion that these frequently may have effects which would lead to underestimates of heredity.

The second major assumption of the twin method is that the non-genetic and genetic influences operate independently. This may be a questionable assumption, especially with regard to certain psychological traits.

In any comparison of identical and fraternal twins the most important step is the decision whether any given twin pair will be diagnosed identical or fraternal. Until recently such zygosity diagnoses had to be based on physical similarity of traits generally thought to be under genetic control: hair color, eye color, size, etc. Conclusions about the heritability of such traits could be criticized as based on circular reasoning. As the genetic mechanisms of more and more blood types became known it became possible to make more accurate diagnoses of zygosity: whenever the two members of a twin pair differ in any blood group they cannot be identical twins. With the blood typing sera available, plus criteria derived from the iris photography, fingerprints, and head X-rays, it was possible to reach about 97 per cent certainty in the diagnosis of the twins in this study. In this connection, it should be noted that any errors of diagnosis will lead to an underestimate of genetic control. Finally it may be pointed out that for many traits we do not possess accurate techniques of measurement yielding results which can be quantified. Most of the errors in the measuring techniques can be expected to be random. They would affect data for both types of twins equally. To the extent that faulty measurements cause identical twins to appear less similar than they really are, the effect of heredity will be obscured.

The psychological tests fall into three main categories: cognitive tests, personality tests, and tests of motor coordination. Since the statistical analysis of these results is not completed, we can generally only indicate the kinds of questions we are asking and the sorts of answers we may receive.

The cognitive tests are aimed at measuring a variety of intellectual abilities. A person may be poor at certain tasks, say mathematical problems, while he is good at other tasks which might for instance depend on verbal ability or mechanical insight. Therefore, tests were selected which would measure these different aptitudes separately, such as Thurstone's battery of verbal ability, arithmetic ability, spatial visualization, memory and reasoning ability. A few of the many other tests included were the Vocabulary Test of the Wechsler Intelligence Scale for Children, the Miller Mechanical Insight Test, and the Stanford Spelling Achievement Test.

In addition people differ in the speed with which they can solve problems. For a few selected tests a record was made of the time required for completion of each problem. We were thus able to determine to what extent "personal pace" is under genetic control, and whether this speed aspect is related to the usual measures of intelligence which are based primarily on number of questions answered correctly.

So far it looks as if for certain tasks the "personal pace" aspect may well be inde-

pendent of the accuracy of the performance. Whether this "personal pace" factor is related to temperamental factors remains to be seen.

Psychologists can measure intellectual traits rather accurately. Until recently they have not been quite so successful in defining and measuring personality traits. There are, however, several promising new approaches. It has for instance been shown repeatedly that the perception of certain ambiguous stimuli is to a large extent dependent on the personality of the observer. For this reason a number of perceptual tasks were included in this study.

In addition it has been shown that personality traits play a part in the performance on tests which require the learning of a new coordination of eye and hand. Several such motor-coordination tasks were administered to the twins. Also included were several personality questionnaires and a vocational interest form.

Other measures of individual differences in personality can be obtained by recording the reaction of the autonomic nervous system to sudden noise or other startling events. (The autonomic nervous system controls such aspects of emotional reactions as breathing rate, heartbeat, blushing, etc.)

By making a continuous recording of the changes in heartbeat, breathing rate and the electrical resistance of the skin (psychogalvanic reflex"), we hoped to discover the role of heredity in the determination of the marked differences found among people. These differences could be both of the degree and kind of reactions shown.

The results of our heritability calculations to date are to some extent in agreement with previous reported findings and also with popular ideas about hereditary factors. As might for instance be expected, the degree of hereditary control over such anthropometric variables as stature or span exceeds that for most psychological traits.

Of the biochemical variables lysine appears to be about as much under hereditary control as are the anthropometric variables while most of the other biochemical variables were found to be more subject to environmental influences.

Figure 1 illustrates the relative importance of heredity for some variables. The striped bars represent the within-pair variance of the identical twins while the blank bars represent the within-pair variance of the fraternal twins. (For easier visual comparison all within-pair variances of the identical twins were made equal.)

The psychological tests differ considerably in the degree of heritability. Some of the cognitive variables appear to be much more under hereditary control than are others. In previous studies intelligence tests were used which were heavily loaded with items measuring verbal intelligence. Our findings so far indicate that several of the other factors in intelligence are as much or more under hereditary control than is verbal intelligence. An example of a non-verbal test which measures one of these factors is Raven's Progressive Matrices test.

Among the other factors not shown in Figure 1 are spatial visualization and perceptual speed. The latter is the name proposed by Thurstone for the ability to perform quickly relatively simple tasks of comparing and checking numbers or designs. Certain aspects of motor coordination such as dexterity or rotary pursuit also appear to be more under hereditary control than is verbal intelligence. Perhaps most surprising is the finding that some aspects of personality as measured by several of the part-scores on certain questionnaires are as much under hereditary control as are some of the intellectual performances.

Several questions are raised by these results. Some of these we hope to be able to answer in the course of data analysis now under way. First of all, it may be asked if all of these measures are separately controlled by heredity. It may be that some of them are highly correlated, so that we are

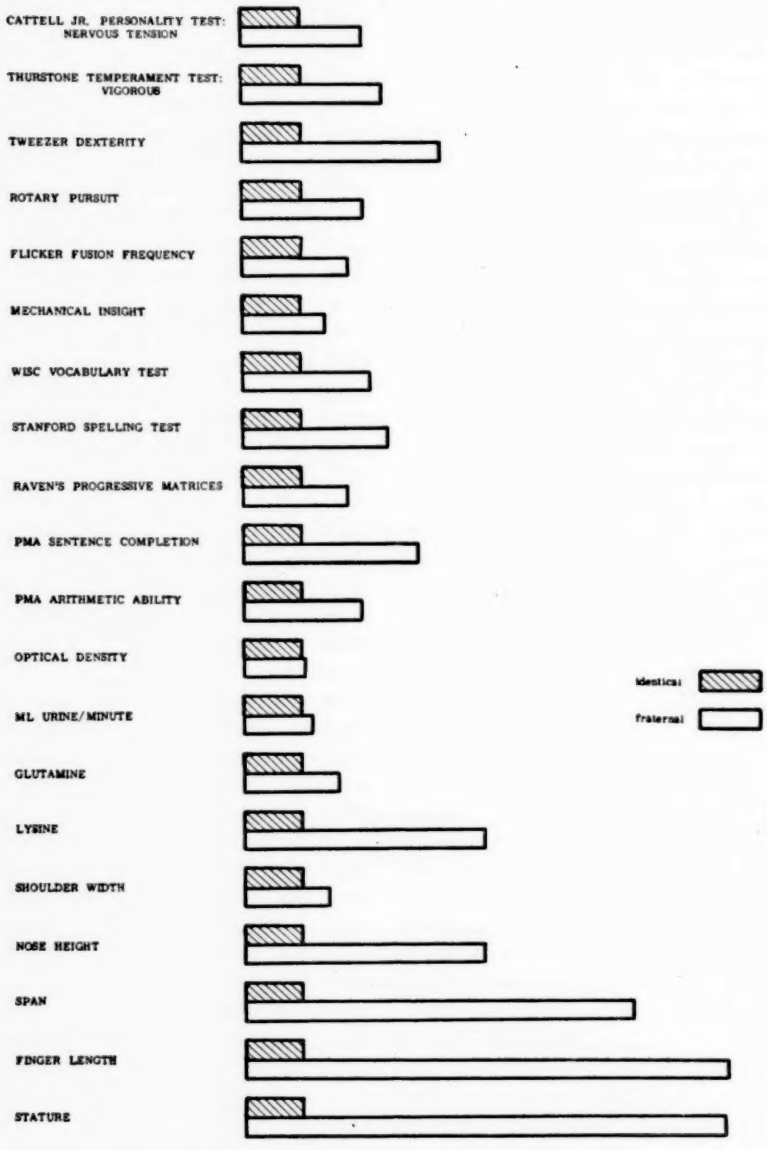

FIGURE 1. A COMPARISON OF THE WITHIN PAIR VARIANCE OF IDENTICAL AND FRATERNAL TWINS FOR A FEW ANTHROPOMETRIC, BIOCHEMICAL AND PSYCHOLOGICAL TRAITS.

repeatedly measuring the same underlying traits. This might even be true for traits for which there does not exist a high correlation in the general population. The effect of the environmental influences might well be to attenuate and obscure correlation due to genetic interrelationships.

If relationships exist between anthropometric and psychological variables such as are claimed by Kretschmer or Sheldon, one would expect to find evidence for this in our data. (4)

Another question which we hope to answer has to do with the various theories about the nature and organization of human intelligence. Psychologists in England generally hold that it is most profitable to regard intelligence as a general capacity. They admit that one can distinguish some specific abilities but their treatment tends to minimize the importance of specific factors. On the other hand most American psychologists feel that this "general-factor" theory of intelligence makes intelligence a rather vague, abstract quality while specific abilities like verbal ability, spatial visualization, or reasoning ability are much more concrete entities.

A comparison of heritability estimates of these special abilities with heritability estimates of general intelligence will be of great help to ascertain the relative merits of these competing theories.

It is a long-standing tradition in psychology to regard intelligence and personality as two separate aspects of an individual which at most exert some slight influence on one another. Recent studies on animals have shown that—for animals at least—this distinction is perhaps not always useful. It may be that the distinction reflects in part a philosophical tradition rather than empirical facts. Data from this study may throw some light on this question.

Besides these theoretical issues which are of interest primarily to psychologists, the practical contribution we hope to make to human genetics will be one of indicating which techniques or tests appear to be measuring best those psychological traits found to be under genetic control. Future workers in this area may thus benefit from our work by choosing traits for which the more accurate techniques are available.

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SOCIAL CHARACTERISTICS AND FERTILITY

A Study of Two Religious Groups in Metropolitan New York

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Introduction

DEMOGRAPHERS HAVE LONG RECOGNIZED the importance of religious composition to any study of population. In particular, knowledge of the religious composition of populations in large metropolitan areas containing large numbers of "minority" groups appears to be essential for a meaningful interpretation of population trends. The present study deals with the population of a school-district area in Brooklyn which is composed of large numbers of Catholic and Jewish inhabitants.

This is a middle-class area characterized by large multiple-dwelling, postwar housing averaging about $25.00 per room per month rental. There are also a substantial number of small private homes, almost all of postwar construction. The entire area is residential, and commercial pursuits are confined to rental and service enterprises.

The sample used for the present study is composed of the entire senior class of the academic year 1953–54 in the new postwar junior high school serving the area. This class numbered 410 white students of about 14 years of age and equally divided between males and females. Approximately 60 per cent of the sample were classified Jewish and 40 per cent as Christian. Approximately three-fourths of the Christian sample were Catholic; the remaining quarter were Protestant. From records and interviews data regarding size of family, I.Q. score, and occupation of father were obtained for each student.

Average Size of Family and I.Q. of Respondent

The average number of children in the family was found to be 3.53 for Christians and 2.29 for Jews. The families were classified according to the I.Q. score of the student and the average numbers of children by I.Q. class and religion were presented in Table 1.[1] The differences between the two religious groups are quite evident. Perhaps of greater interest are the differences between the I.Q. classes within each religious group. From past studies one would expect an inverse relationship between I.Q. and size of family.[2] Such a relationship is

TABLE 1
AVERAGE NUMBER OF CHILDREN PER FAMILY BY I.Q. AND RELIGION

I.Q. Score	Christian			Jewish		
	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
130 and above	13	2.69	1.27	76	2.26	.93
120–129	14	3.14	2.17	33	2.30	.77
110–119	26	3.12	2.02	54	2.15	.80
100–109	35	3.80	2.68	38	2.21	.66
90–99	30	3.53	2.31	29	2.45	.67
Below 90	42	3.98	2.18	16	2.81	.95

[1]The I.Q. scores are from the *Pinter-Cunningham Test of General Intelligence*, a group-administered test standardized to a score of 100 for the United States school population of comparable ages. These tests were administered within one year prior to the collection of the data.

[2]Anne Anastasi, "Tested Intelligence and Family Size," *Eugenics Quarterly*, 1 (September, 1954), pp. 155–160.

TABLE 2

AVERAGE NUMBER OF CHILDREN PER FAMILY BY BROAD OCCUPATIONAL CLASS OF FATHER AND RELIGION*

Broad Occupational Class	Christian			Jewish		
	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
Professional and Allied	7*			32	2.09	.73
Managers, Proprietors, Officials	33	3.15	1.75	190	2.28	.85
Clerical, Sales	24	2.92	1.18	51	2.37	.87
Craftsmen, Foremen	45	3.44	2.16	21	2.43	.73
Operatives and Kindred	28	3.57	2.34	25	2.40	.75
Service Workers	26	4.88	2.87	7*		
White Collar	64	3.03	1.75	192	2.28	.82
Manual	99	3.86	2.47	53	2.32	.80

*Means based on fewer than twenty cases are not shown.

found within the Christian sample, but no clear relationship can be found within the Jewish sample. There is virtually no difference in the average size of Jewish families among the various I.Q. classes. Furthermore, the much higher standard deviations within each Christian I.Q. class indicate a large amount of variation in family size within each I.Q. class as well, a condition not found within the Jewish group.

When the average number of children per family for each religious group was standardized by the I.Q. distribution of the entire sample, it was found to be 3.21 for Christian and 2.31 for Jewish families.

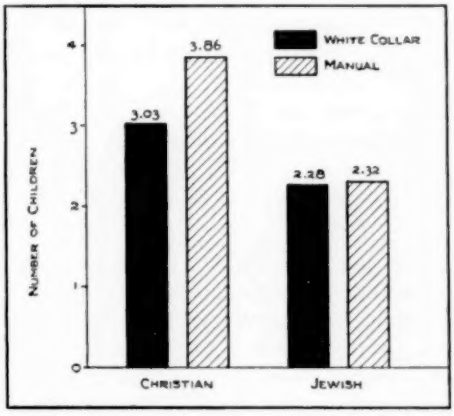

Figure 1. Average number of children per family by occupational class of father and religion

Average Size of Family and Father's Occupation

The average number of children in families classified by the father's broad occupational class is presented in Table 2. The greater average number of children in Christian than in Jewish families persists at each occupational level. Again, however, the pattern of fertility differentials by occupational class is quite different in the two religious groups. A very definite inverse relationship is found for the Christian group while virtually no differential fertility by occupational class exists within the Jewish sample. The large standard deviations obtained within each occupational class within the Christian group suggest, moreover, that there is a great amount of family size variation within each occupational class. Such variation is not found to any marked degree for the Jewish sample. It can be seen from the figure below that while the average number of children in Christian manual-class families is 27 per cent greater than for white-collar class families, no such differences exist among Jewish families.

When the average number of children per family for each religious group was

standardized by the occupational distribution of the entire sample it was found to be 3.31 for Christian and 2.26 for Jewish families.

Correlation Between I.Q. and Size of Family

Numerous correlations have been presented to express the relationship between I.Q. and size of family. These have invariably been negative and have usually fallen between —.20 and —.30.[3] The coefficient of correlation between I.Q. test scores and size of family was found to be —.24 for the entire sample. This figure appears to be quite consistent with past studies. The correlations for the religious subgroups, however, are quite different; —.16 for the Christian group and —.11 for the Jewish group. The coefficient of —.24 for the entire group was found to be significant; —.16 for the Christian group was of borderline significance, and —.11 for the Jewish group was not significant, also a borderline case.[4]

The fact that a higher and more stable correlation coefficient is secured for the combined sample than for the Christians and Jews separately is highly indicative of the relative composition of the subgroups in relation to these variables. The distribution of family size within the Jewish sample is skewed toward the smaller families while that of the Christian sample is skewed toward the larger families and the distribution of I.Q. scores within the Jewish group is skewed toward the higher levels while that of the Christian group is skewed in the opposite manner. When combined, the extreme deviations of both groups are minimized. A result such as this would imply, statistically, that the two subsamples did not come from the same population.

Correlation Between Father's Occupation and Size of Family

For purposes of correlation, the North-Hatt occupational prestige scale was used.[5] The coefficient of correlation between this value and size of family was found to be —.25 for the entire sample and the Christian subsample, and —.06 for the Jewish group. The former figure is significant, the latter is not. While an inverse relationship is suggested for the Christian group, the lack of any relationship is suggested for the Jewish sample.

It has been said that there has been a rather constant trend toward effective contraceptive practice and that the inverse relationship between fertility and occupation is in the process of reduction in the United States.[6] Clearly, the spread of successful contraceptive practice will bring about a diminution in this inverse relationship and, under certain conditions, it may bring a reversal. A direct relationship between occupation and fertility has been observed for the "number and spacing planned" couples in the *Indianapolis*

[3]J. Crosby Chapman and D. M. Wiggins, "Relation of Family Size to Intelligence of Offspring and Socio-Economic Status of Family," *Pedagogical Seminary*, XXXII (September, 1925) pp. 414-421; H. E. G. Sutherland and G. H. Thompson, "The Correlation Between Intelligence and Size of Family," *British Journal of Psychology*, XVII (October, 1926), pp. 81-92; Theodore Lentz, Jr., "Relation of I.Q. to Size of Family," *Journal of Educational Psychology*, XVIII (October, 1927), pp. 486-496; J. B. Maller, "Vital Indices and Their Relation to Psychological and Social Factors," *Human Biology*, V (February, 1933), pp. 94-121; Frank Lorimer and Frederick Osborn, *Dynamics of Population*, New York: Macmillan, 1934, pp. 194-195; Frank Lorimer, "Trends in Capacity for Intelligence," *Eugenical News*, XXXVII (June, 1952), pp. 17-24; James Maxwell, "Intelligence, Fertility and the Future," *Eugenics Quarterly*, 1 (December, 1954), pp. 244-247.

[4]Statistical significance implied P $\leq$.05, *i.e.*, at the 5 per cent level.

[5]The North-Hatt Scale is a numerical scale of scores based upon comparative prestige ratings as obtained by nationwide survey. Cecil C. North and Paul K. Hatt, "National Opinion on Occupations," *Opinion News*, IX (September, 1947), pp. 3-13.

[6]Charles F. Westoff, "Differential Fertility in the United States: 1900 to 1952," *American Sociological Review*, 19 (October, 1954), pp. 549-561.

Study.[7]

Since it appears well-founded to assume that contraceptive practice is far more widespread among the Jewish sample in the present study than among the Christian sample (75 per cent Catholic), we may accept the lack of differential fertility as a result of this factor.

Conclusions

It appears clear, in so far as the data allow, to conclude that the relationships between fertility and I.Q. and occupation are quite different for the two religious groups. The fertility behavior of the Jewish group appears to be quite homogeneous, manifesting little or no differentation when "controlled" by I.Q. and occupation. The Christian fertility, on the other hand, demonstrates variability and it is inversely related with I.Q. of the student and occupation of the father.

A multiple correlation reveals that the variables of I.Q. and Occupation "account for" a little more than 7 per cent of the variance of fertility for the Christian group but they "account for" only a little more than 1 per cent of the variance of Jewish fertility. Although the data are far from definitive, they do strongly suggest that variance in fertility in relation to social characteristics is less within the Jewish group than within the "Christian" group of the community studied.

[7]Clyde V. Kiser and P. K. Whelpton, "Social and Psychological Factors Affecting Fertility. IX. Fertility Planning and Fertility Rates by Socio-Economic Status," *Milbank Memorial Fund Quarterly*, XXVII (April, 1949), pp. 359-415.

GENETIC-HYGIENIC IMPAIRMENT THROUGH INCESTUOUS MATINGS*

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MOST WESTERN SOCIETIES FORBID matings between members of the same family. Some restrictions of that kind have biological consequences, reducing the numbers of matings between individuals that have at least a 25 per cent chance of having a given chromosome of common origin. Matings of this kind occur between parent and child, brother and sister; grandparent and grand-child, halfbrother and halfsister, uncle and niece, aunt and nephew. Notwithstanding the motivations for such prohibitions, they reduce the incidence of homozygosity for rare recessive genes. Such genes are, in human genetics, best known when causing weakness, illness or specific defects. It would, then, seem possible that transgressions of the incest barrier would cause ill effects to the offspring. The present series illustrates some aspects of that problem.

Data on 6,097 inmates of institutions for mental defectives were filed and completed as to birth district and parentage. Thus 4,466 individuals were observed to have been born to identified parents within Götaland, a South Swedish region inhabited by 3.4 million people, *i.e.*, 49 per cent of the Swedish population. Of those 4,466 defectives 14, or 0.3 per cent, were from matings prohibited by a law valid until 1937. One aunt-nephew mating, included in the number of 14, was detected in 1939 when cohabitation with a sibs child was not prohibited; in this case the mating was still illegal because of the mental disease of the mother. When the number of matings between identified individuals was considered, 14 out of 4,255 were incestuous, *i.e.*, 0.3 per cent.

This incidence of incestuous matings, of the order of first cousin marriages stated for some Central European populations, could be compared with the observations by Kinberg, Inghe and Riemer (1943) of about 30 cases of legally recognized incest each year in Sweden, or 0.5 per 100,000 individuals. About one-fourth of these incestuous unions in the general population occurred between step-father and step-daughter; in the abnormal material presented here one such mating was included among the 4,255 producing mentally defective offspring, but not in the series of 14 close kin matings.

In 58 cases of incest between father and daughter, speciallly studied by Kinberg and co-workers, 17 resulted in pregnancy, or 29 per cent. Lacking more precise data for comparison with the present series, an estimate of 30 births each year would mark the upper limit of issue from legally recognized incestuous unions in the general population. When the yearly number of births in Sweden was taken as roughly 100,000 for the period under investigation, the institutional series contained at least the tenfold rate of incestuous offspring as compared with the legally recognized incidence in the general population.

Out of 14 incestuous births in the present series 13 were rural, defined by the

*Aided by a grant to the Institute of Genetics from the Rockefeller Foundation and by a personal grant from the Royal Physiographic Society.

mother's residential community. A higher rural incidence could be expected, as Sondén (1936) had observed that incest was more than twice as frequent in rural districts as in towns. In the present series efforts to secure the identity of fathers even in the many illegitimate unions were in vain in 359 cases, where the proband was born in Götaland. Among these 359 births 229 were rural, or 63.8 per cent, whereas 2,608 of 4,466 probands with known fathers were born in rural districts, or 58.4 per cent. The difference is significant at the five per cent level, but might be partly due to technicalities in registration of birth communities. Three of those unknown fathers of rural probands were said to be identical with the mothers' fathers, though legal proof was lacking. It is not excluded that the incidence of incest matings was still somewhat higher than this suspected frequency of about one per cent of incests between parents of illegitimately born defectives. The incidence of incestuous births among individuals born in wedlock was not necessarily nil, but still more inaccessible to any estimate. However, since serious forms of incest were, until 1937, punished as sternly as manslaughter or first degree murder, and common opinion is strongly against sex offenders, any conjecture at essentially higher frequencies of mental defectives through incest matings in South Sweden, than observed in the present series, would need additional proof. Possibly 16 out of 2,837, or 0.6 per cent, would not be too far below the real maximum incidence of incestuous births in rural districts within Götaland, of mental defectives of institutional level, needing special care. Absence of vast city slums (cf. Kinsey and co-workers, 1953) in the region under study admits of reduction, to perhaps 0.3 per cent, of the maximum incidence of such births in urban districts.

Could such estimates be extended to the larger group of perhaps 120,000 mental defectives in Sweden? If so, 360 to 720 of them would stem from incestuous unions, a yearly contribution of six to twelve mental defectives from incestuous matings, provided that the life span of the defectives measured 60 years. These estimates are somewhat arbitrary, but would probably not be transgressed to any considerable extent. As held forth by Penrose (1949), the incest situation tends to make for institutionalization of the offspring; thus the incidence in an institutional series such as this one would be higher than among defectives outside of institutions. Three legally recognized incestuous births per one thousand mental defectives in the general population would, then, be a maximum incidence.

A limited number of recessive genes are known to cause mental deficiency, mostly of severe degree. Since such genes are rare, the parents of homozygotes are expected to be heterozygotes, and free from the phenotypic manifestation of the gene. In the present series of 14 probands from incestuous matings such was frequently not the case, subnormal or defective intelligence occurring in one or both partners of at least nine incests. So far the findings are in accord with observations and interpretations of Penrose (1938, 1949), and Kinberg and co-workers (1943); very often incest is due to the subnormal or defective intelligence of the partners.

Under such circumstances the genetic-hygenic impairment through incestuous matings is mainly brought about by defectives breeding their kind. When incest births are rare, as was probably the case in the region under study, they add little to a huge class of defectives. A raised frequency of such births would increase the smaller category of individuals mentally disabled through recessive genes.

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HEREDITY COUNSELING
The Role of the Doctor*

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MOST PHYSICIANS ARE CALLED UPON to give genetic counseling from time to time. The patient expects the answers he gets regarding heredity in his family to be of the same high quality as the surgical or other medical counseling which he receives. Most physicians, however, have had little training in medical genetics and may not be able to give professional service in this field. The reason that training in medical genetics is still inadequate is that the subject is new, and space in the medical curriculum has not yet been found for it in very many medical schools.

Where are the facts to be found which are needed for counseling in medical genetics? They are scattered throughout scores of scientific publications, and some of the most useful of these are unavailable to the practitioner. There are a few texts which describe how heredity works for each one of the vast array of human anomalies. But there are expensive and cumbersome, and none of them gives the physician much help in the job of translating the science of human genetics to his patients.

Why should the doctor try to explain to the patient that a predictable percentage of his children will display the abnormality that concerns him? The fact that the patient wants the information is one good reason. In addition, it may make the difference between happiness or sorrow for a generation or more in the future.

The physician may obtain assistance from the professional geneticist at the heredity clinics throughout the country. But counseling in medical genetics at the "grass-roots" level will have to be done by the family physician in the vast majority of cases.

It is the physician who is likely to have a hand in shaping the future evolution of mankind because our reproduction is no longer completely capricious. The desire for a happy family of normal children is one of the strongest human motivations. For the first time in history the physician is able to be of major assistance in achieving this highest of life's goals. If the couple are sterile, he may help in bringing about fertility. If the couple find that the family is increasing beyond their fondest expectations, he can slow down the flood. In civilized countries responsible parents no longer leave reproduction to the vagaries of chance. The physician officiates at the birth of the child and is the authoritative source of scientific information about reproduction.

The physician of today not only helps

Extracts from *Counseling in Medical Genetics*, by Sheldon C. Reed, W. B. Saunders, Philadelphia and London, 1955, 286 pp. By permission of the author and publisher.

the couple to achieve a family size which is appropriate to their environment, but, by means of genetic counseling, he can assist them to approach the quality of children they desire. A couple who have had five boys, three doomed to die of progressive muscular dystrophy, succeeded in producing the quantity of children they wanted but they are most unhappy that three of their children will never become men. The physician of tomorrow will very probably be able to guarantee them five normal boys. At least, he will be able to tell a mother such as the one above whether or not she carries the sex-linked gene for progressive muscular dystrophy. This mother had lost a brother with the disease, and the physician of today could have told her that she had an even chance of carrying the abnormal gene. Most of the techniques for improving man's genotype are still in the future, but at no time in history have we been in the favorable position that we are in today. The fact that life expectancy has been doubled in a few generations is not due to the faith-healer and the quack but to the physician who is using his science with a sense of responsibility which it would be difficult to match. Today his responsibility includes helping the couple with their problems of heredity and reproduction.

The point which is being approached is this. In the United States today practically all fertile couples know that they can regulate their family size to a considerable degree by using either the rhythm method or contraceptives. A good proportion of them also know that something can be done to avoid the appearance of abnormal children, whether the abnormality be due to environmental or genetic factors, or both. Obviously, they are going to ask the physician for answers to their questions. The time has come when the physician can give correct answers to a large number of these serious pleas for knowledge.

Each of the questions is likely to be different from the others. and each is a different puzzle. The physician must put a number of pieces together in order to solve the problem. The best that the geneticist can do is to supply some of the pieces of the puzzle. In the last analysis, it is the physician who will have to fit the pieces together. In the puzzle will be pieces supplied by biochemistry, economics, religion, social class concepts, medicine, genetics, and most important of all, common sense.

The geneticist can supply the essential data, but he has no real rapport with the couple. He is not a part of the family and cannot decide whether or not the couple should try to have more or fewer children, depending upon the genetic problem which is being faced. The family physician is in a better position. He is the medical and biologic advisor to the family, and the members want him to help them in making their decisions regarding their own reproduction. How much assistance can be given depends upon the always slightly different pieces of the puzzle which have to be fitted together.

Life would be intellectually simpler if we could abolish all science. We could suppress nuclear physics as we once outlawed the crossbow. But as long as man has his brains, we can't completely stifle his curiosity about himself and the world around him. It looks as if science and the physician are here to stay. We have passed the point of no return.

The practice of medicine is often referred to as an art, but it is an art which must be restricted to scientists. The physician is the chief scientist with whom the ordinary family has personal contact. It may come as something of a shock to the physician to realize that man's future evolution rests upon the doctor's ability and judgment. Man's evolution depends upon changes in his heredity. There will be no appreciable change in the genotype of the species in one year, nor will one physician cause much variation of the genes. However, over the millenia there will be changes and they must come at the family

level, which is where the doctor functions.

The discovery of insulin was dysgenic in that it permitted those with the heredity for diabetes to live and increase the incidence of the deleterious gene over what it would have been had they died, as happened in the past. This type of evolution has occurred, and will become even more frequent as the genes for one disease after another are overruled by medical advances. We will eventually, as a species, be carrying a heavy load of defective heredity which we will patch up with false teeth and artificial organs of every description. This won't happen overnight. The speed at which it comes about will result in large part from the success of medical research balanced by the quality of genetic counseling provided by the physician. It seems probable that our evolution in the future will be much more rapid than it has been in the past.

There isn't any question that our immediate social advances or calamities will depend upon other factors than gene changes. It is the gene changes over periods of thousands of years which will gradually become the responsibility of the medical profession. At present the physician's major responsibility is to learn how to ensure a family of happy, normal children for each couple. Even for this immediate obligation there is still much to learn.

BOOK REVIEWS

MEDICAL RESEARCH: A MIDCENTURY SURVEY. Vol 1: American Medical Research: in principle and practice. 765 pp. Vol. II: Unsolved Clinical Problems in Biological Perspective. 740 pp. Edited by Esther Everett Lape and Associates. Published for the American Foundation. Little, Brown & Co., Boston, 1956, $15 the set.

For fifteen years the American Foundation has conducted a thorough and critical survey of current trends in medical research in the United States. From this survey there have arisen these two volumes which, for many years to come, will serve as a source of information and a powerful guide and direction to American medicine. The Foundation, its member-in-charge, Esther Everett Lape, and her associates have assumed the responsibility for their authorship. They are joined by a distinguished Committee of Consultants which has endorsed their major conviction—that fundamental research in the biological sciences, aided by chemistry, physics and mathematics, is of imperative significance in the solution of outstanding clinical problems. The report supplies a definitive orientation and a searching analysis of the overall picture in medical inquiry today.

To those concerned with the organization and financing of research, these volumes should provide a philosophy and a rationale. The picture they present is humbling but also very hopeful. Without sensationalism or over-optimism, they give the promise that unselfish, cooperative research into the basic questions of life will slowly lead medicine to the day when it can begin to think in terms of treatment and prevention, based, not on luck and empiricism, but on the knowledge of causes and mechanisms.

The educated layman will perhaps for the first time learn in these volumes what hundreds of dedicated researchers have long known—that progress in medicine is made not only in the medical school and the clinic, but also in the university, the institute and the laboratory. In all these settings, in the spirit of free inquiry, scientists of all training—physicians, biologists, chemists, physicists and mathematicians—work, separately and together, on the fundamental mechanisms that underlie health and disease. The book does not hesitate to call attention to the imperfections that exist in the framework of research. Some of the conditions discussed in detail in the first volume include the relation between government and science, the problem of funds earmarked for "practical" results or guided by emotional rather than scientific considerations, the shortage of trained workers and the problem of recruiting full-time staffs in universities and medical schools. Page after page bears evidence of a fair and thorough critique, unrelenting, however, in its faith in basic scientific inquiry.

Volume I illustrates the agencies involved in American medical research. It provides a comprehensive picture of the content and, just as important, the organization of the research being done at universities, medical schools, foundations, hospitals, industrial organizations, federal departments and bureaus and voluntary national health societies.

Volume II reviews some of the trends in basic research today, illustrated by a study of nine clinical conditions: cancer, infertility, tuberculosis, virus infection, the rheumatic syndromes, arteriosclerosis, hypertension, alcoholism and schizophrenia. The emphasis throughout is on cellular metabolism and molecular biology.

The specialist in any field of medical research will find in this report an illuminating survey of the entire panorama, in which he can see his own work in balanced perspective. As one of the basic approaches to the problems of biology, the genetic

viewpoint ranks with the molecular, cellular, metabolic and social. Those working in eugenics and human genetics, or interested in the problems of constitutional susceptibility and resistance, fertility, and the inheritance of metabolic patterns, will find the importance of their work emphasized throughout this survey. They will also find an evaluation of progress in these fields compared with other basic areas. Although there is no chapter or section specifically devoted to genetics and allied disciplines, this is only because the genetic approach appears repeatedly as an integral part of each discussion in the book.

In the earliest pages, the editors, discussing the biological basis of medicine, state that there is increasing stress on the concept of constitution and on genetic factors. This is attributed notably to concrete developments in the science of genetics. However it is pointed out that basic research in this field is being pressed only in isolated instances. In government agencies, for example, one of the studies of fundamental significance which is described in the field of atomic energy is the study of the effect of radiation on chromosome structure and the metabolic processes of the cell. This is aimed on the one hand at minimizing the effect of ionizing radiation, and on the other at producing new strains, at least of plants, more resistant to disease. Among foundation-supported work, there is noted the contribution of the Rockefeller Foundation to the study of hereditary factors in mental disease, as well as the Carnegie Institute's work on the nature of genes and chromosomes at Cold Spring Harbor.

The problem of instruction in genetics is discussed at greatest length in the section devoted to the contributions of university zoology departments. Because a committee appointed to consider needed changes in premedical preparation commented, in 1945, on the "pitiful" ignorance of genetics in most medical students, the genetic research in universities is considered in detail. The section concludes by describing the gradual emergence of instruction in this science in medical curricula, but says that "on the whole, activity in human genetics in university biology departments has not yet widely influenced teaching and research in most of the medical schools."

The value of the genetic approach and its findings is illustrated many times in the second volume of this report.

The chapter on *cellular metabolism* presents the evidence that gene action guides, orders and controls chemical reactions within the cell. The relation of gene activity to enzymes and to the constitution of cellular protein serves as a basic area of investigation with profound implications for the many clinical areas that follow.

In *diabetes,* the hereditary factor is mentioned, although referred to as "imponderable." In the chapter on *cancer,* there is a complete discussion of the mutation theory, including the difficulties involved in the concept of a somatic mutation. This is distinguished from theories of gene mutations in germ cells through which the susceptibility of succeeding generations is altered. The chapters on vascular diseases call attention again to the hereditary factors in *hypertension.* The chapter on *tuberculosis* discusses twin and experimental studies on resistance, in which heredity is considered to be the deciding factor. Returning to the cellular level, there is a stimulating description in the chapter on *virus diseases* of the similarities and differences between the virus and the gene, including a description of the plasmagene, a discussion which comes close to the basic problems of living matter. This leads to a section on the appearance of new strains in viruses and its relation to the "biologists' dream that ultimately mutation can be directed beneficently."

Two chapters of special interest to workers in eugenics and genetics are those on

infertility and *schizophrenia*. In the former, the concept of infertility is extended to cover "not only barriers to conception but also anything that prevents production of a normal child capable of continued growth and development, including spontaneous abortion, premature birth, stillbirth, neonatal death, congenital abnormality." The text goes on to state that "it is doubtful whether a Mongolian idiot or an infant doomed at birth to die before it is one year old or to be institutionalized sooner or later for motor disorders or mental defect would be regarded by an infertile couple as an improvement on the barren state." With this approach, the chapter goes on to describe major sources of investigative work in infertility, with contributions by "zoologists, anatomists, embryologists, physiologists, gynecologists and also biochemists, geneticists and animal husbandrymen."

Among the physiological variables affecting infertility in both sexes, research on "genetic factors" is described, while infertility resulting from defects in the female or male reproductive tract is discussed at length. Congenital defect as a cause of fetal or neonatal death leads to a discussion of diet in pregnancy as it affects fetal nutrition, the effect of maternal infection and the theories suggested for the etiology of Mongolism. In connection with this, the genetic and environmental theories are reviewed, and it is stated that "the trend appears to be away from attributing Mongolism and other congenital anomalies and defects exclusively to genetic or exclusively maternal influences . . . Geneticists have pointed out that as gaps in knowledge of reproductive physiology are filled, it will become easier to assess purely genetic factors in congenital defect."

The final chapter of the book is entitled "The Biology of Schizophrenia, illustrating interaction of physiological, psychological and social factors." In this chapter, there is a comprehensive discussion of the role of heredity, in which it is stated that various notable workers, regardless of their approach, have expressed agreement on the hereditary nature of the tendency to schizophrenia. The editors quote Kallmann's description of schizophrenia as "psychodynamically an inability of the individual to be part of the milieu in which he lives," and "genetically a metabolic disturbance in the enzymatic range." It is stressed in this chapter that the heredity concept in psychiatry does not conflict with attention to environmental factors, and the artificiality of the dichotomy between heredity and environment is pointed out. In addition to population and twin studies, the chapter describes many experimental studies in neurobiology, including the crossbreeding program at the Roscoe B. Jackson Memorial Laboratories designed to bring to light underlying differences in canine behavior from strain to strain. A clear presentation of the relation of cultural to constitutional factors concludes the chapter.

In reviewing this book, I have gone into some detail because the book itself presents its thesis more in terms of facts than generalizations. The key to progress in most fields of medical research today may be hard to find. After studying the details so thoroughly gathered from all sources in these volumes, however, one emerges with the conviction that the alliance of the genetic approach with the chemical, cytological and social approaches to human biology proposes the right kind of questions and must therefore yield the right answers. Enlightened support, both financial and academic, will encourage persons with ideas and talent to seek training and contribute to human health at the important level of basic research.

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EVOLUTION, GENETICS AND MAN: Theodosius Dobzhansky. John Wiley and Sons, New York, 1955, $5.50. ix. 398.

The impact of Darwin's *Origin of Species* on Western thought has not yet been dissipated. In fact, the implementation of Darwin's theory by modern genetics has made natural selection not merely a biological hypothesis but apparently the most fundamental law of living matter, with ever widening implications. It is high time that courses on genetics and more general biological subjects made evolution their central theme. Even applied biology and medicine would benefit from this added perspective.

The present book should do much to facilitate the formal teaching of evolution, for it is designed not only as a textbook in biological evolution, but as an ancillary text or collateral reading for general biology and anthropology courses. Indeed, the book is so readable that some parts should be of interest to any educated layman wanting an authoritative view of organic evolution, past and present. The reviewer found no chapters and very few pages so specialized or so familiar that he wanted to skip them, and some parts present evolution in its most fascinating aspects. Many chapters have sufficient interest and autonomy to be read by themselves. Such are Chapter 1 on fundamental biological concepts, Chapter 5 on elementary evolutionary changes, and Chapters 12 and 13 on the fossil and living record of evolution.

Chapters 2, 3 and 4 are a concise introduction to modern genetics. In these chapters, and throughout the book, history is woven in as a major part of the "woof," while the "warp" is determined entirely by the logical structure of the subject. Thus Chapter 2 begins with Mendel's experiments, but explains Mendelian traits in terms of genes and goes on to discuss modes and principles of gene expression. Chromosomes are not mentioned until the third chapter. All topics are related, where feasible, either to evolution or to man.

Chapters 5 to 8 develop the modern concept of evolution by natural selection. The next three chapters present more specialized topics in evolution, some of which are still under investigation or debate. Chapter 12 is a résumé of the fossil record and chapter 13 describes human evolution in terms of fossils and in terms of races. Chapter 14 is entitled "Chance, Guidance and Freedom in Evolution," and here Dobzhansky outlines the major scientific and philosophical debates relating to evolution. Without undue dogmatism, he convincingly disputes supernatural explanations of evolution and shows the competency of the theory of natural selection to explain all evolutionary observations.

Almost every chapter in this book contains statements that deserve to be quoted. The following selections are representative of the book's wisdom:

On the causes of extinction (p. 367): ". . . natural selection is opportunistic and, like any natural process other than the human mind, lacks foresight. Selection perpetuates what is advantageous here and now, and fails to perpetuate what may be beneficial in the future unless it is also immediately useful."

On evolution as revealing a divine purpose (p. 374): "Evolution does not strive to accomplish any particular purpose or to reach any specific goal except the preservation of life itself. Evolution did not happen according to a predetermined plan. Nevertheless, when man contemplates the whole perspective of the evolution of the Cosmos, he can see that the origin of mankind was one of the outstanding events in the history of creation by evolution."

Yet biological theory does not replace religion (p. 378): "Evolutionary ethics have not been [successfully] formulated yet, and one may reasonably doubt that they can be made scientifically convincing or aesthetically satisfying."

On races (p. 161): "The human species, and other species, contain as many races

as we can see fit to distinguish." But (p. 136) "the notion of 'pure' race is absurd."

On eugenics (p. 377): "Man knows not only that he has evolved and continues to evolve, but that he is also in the process of learning how he may promote his own evolution in the direction of his choice. But what should be the basis of the choice?"

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GENETICS AND METABOLISM: Robert P. Wagner (University of Texas) and Herschel K. Mitchell (California Institute of Technology). John Wiley & Sons, Inc. New York, 1955, 444 pp., $7.50.

"Genetics and Metabolism" is essentially an advanced textbook in genetics stressing wherever possible the biochemical aspects of heredity. A central thesis of the book is the important concept that in genetics we must be concerned not only with the inherited differences which we see but even more so with the inherited processes underlying these observable differences. Biochemically this means an understanding of the factors affecting rates of biochemical reactions and metabolism, for it is certainly through such processes that genes must exert their effect. This point is stressed throughout the book.

The introductory chapters cover basic genetic information and are apparently designed for the biochemist and other interested non-geneticists. Possibly some geneticists will feel that the authors should have had the same consideration for their fellow workers when it comes to the strictly biochemical parts of this text. Two chapters are devoted to a discussion of inherited biochemical characters and the point is well made that the major problem in the advancement of this work is chemical rather than genetical. The next three chapters center around the concept of the gene as an agent of metabolic control. Pertinent problems of biochemistry, particularly enzyme kinetics, are covered, and the complexities of genetic control of enzyme systems are well discussed and illustrated. The following two chapters are concerned with allelism, pseudoallelism, allelic interactions, and non-allelic interactions. Interesting biochemical interpretations of these phenomena are given. The final chapters deal with the important problems of environmental modification of the phenotype, cytoplasmic inheritance, and the control of development. Biochemical interpretations are given wherever possible, and this is particularly well done for the chapter on the environmental modification of phenotype.

The book is well documented throughout, and many important contributions are covered in considerable detail. This should be particularly helpful where this volume is used as a textbook. Unfortunately this is not an easy book to read, but for those workers with some background in biochemistry who wish to keep abreast of the rapidly expanding field of biochemical genetics, the labor it requires will not be in vain.

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UNCOMMON PEOPLE: A STUDY OF ENGLAND'S ELITE: Paul Bloomfield, Hamish Hamilton Ltd., London, W. C. 1, 1955, 219 pp. 21s.

The uncommon people of this book are of diverse sorts but throughout five or more generations one or more members of each family strain has shown high achievement. For example, of one of the strains, 13 have been prime minister out of a total in those years of 45. Two other strains have had a Fellow of the Royal Society for five generations. Others have been significant initiators, for example, Florence Nightingale, Lloyds of London, Henry Fielding (author of the first great novel, *Tom Jones*), Thomas Wedgewood

("the first photographer"), Elizabeth Fry (prison reform), Wilberforce (ended British slave-trading), T. B. Buxton (freed all slaves in the British Colonies), Charles Darwin.

The five sires especially discussed are George Villiers, Robert Barclay, Thomas Wedgewood, James Stephen, and Lord Burghley Cecil. It is repeatedly pointed out that mothers are as significant as fathers biologically; many of the eminent descendants of these five sires trace through daughters. This volume discusses more than 100 named families which have here been traced back to one or more of these five great sires.

The high achievement of descendants of these sires correlate with the possession of a conspicuous supply of intelligence and four or more of the following traits: exceptional zeal, zest, vigor, attractiveness or charm, persistence, cooperativeness, adaptability, imagination, courage and self-confidence.

There was a notable amount of intermarrying of these strains and of inbreeding, the marrying of cousins within each strain. This was especially true of those descended from the eminent Quaker Robert Barclay. Darwin's mother was a Wedgewood, and Darwin married a first cousin, a Wedgewood. Francis Galton and Charles Darwin had a common grandfather.

This volume presents much detailed geneological information concerning hundreds of notable persons. Some significant quotations are given below.

"It is not enough to devote attention to exceptional abilities that have been running in families, *old* families. They may start running in *new* families. It is a liberal and democratic axiom that they should be encouraged to do so. Belief in this is implicit in my thesis, which is inspired by the knowledge that a bad environment may hinder uncommon people from making the best of themselves, particularly if they are gentle and unpushing, though on the other hand the best environment cannot be expected to bring out talent if it is not there, inborn or inherited." (pp. 2, 3)

"'Improve man,' Amiel wrote in his wonderful journal, 'make him more just, more moral, more humble, more pure—this is the only reform which has no correlative drawback.'" (p. 14)

"Dr. Julian Huxley made the impressive statement that in his opinion the most important new fact of the last fifty years, not excluding the rise of Communism or atomic experiment, was 'that the human species had begun to take stock of its position in the world.'" (p. 16)

"The right way of improving man is to offer to *virtu* or hereditary force of character the advantages of civilised nurture. There is general agreement that children thrive on a happy and interesting home life, all the better if there are traditions to be proud of." (p. 18)

"Nobody could put down to opportunism or favour the prosperity of the great Quaker cousinhood descended from Robert Barclay." (p. 47)

"Robert Barclay not only had moral and physical courage, and brains, but was what he was from the start. So far from having to vent his aggressiveness at any time, his friends recorded that they had never known him to lose his temper." (p. 53)

"History shows that charm is as much an advantage to a woman as beauty. In three hundred years many Villiers women have been beautiful, but that wise man, Lord Keynes, reflecting on the tremendous influence exercised by their line has attributed it, both in the women and the men, to their charm of personality and a certain hard core of egoism. The outstanding men have had something more than ability. Efficiency is not so rare, cleverness abounds. Live wires are common. The

Villiers elite have shown boldness of imagination in high degree, and courage to stand by their guns." (p. 58)

"G. M. Trevelyan wrote of Marlborough that he gave England better value for every guinea he received than any other of her servants. . . . By the light of his unclouded genius he protected the advent of the much needed age of reason, toleration and common sense." p. 59)

"The Quakers, beneficiaries of the new age of 'reason, toleration and common sense,' were against notoriety, titles, inequalities and ostentation. They supported humanitarian causes such as the abolition of slavery and the reform of prisons and lunatic asylums. Many of them *looked* and even more *behaved* as if they were aristocrats without much superfluity of apparatus." (p. 60)

"The elite quality is inseparable from a disposition to promote the cause of liberty. Liberty? The opportunity for everybody to live by earning a livelihood under decent conditions, and for those capable of doing better than that to do better—but not at the expense of the rest of the community . . . . . with solicitude either for the common people, or for the decent and efficient conduct of public business, or for both." (p. 92)

"They were all brave, and had great spirit though not in every case physical stamina. It never seems to have occurred to any of them that they had been born for any position in the State except the highest." (p. 100)

"This new middle-class elite in the first half of the nineteenth century recruited themselves into the unarmed services (except diplomacy)—largely their own creation. Sir Charles Trevelyan opened the Civil Services (again, except diplomacy) to competition in 1853." (p. 114)

"From the histories of pairs of identical twins, Galton decided that 'there is no escape from the conclusion that nature prevails enormously over nurture when the differences of nurture do not exceed what is commonly to be found among persons of the same rank of society and in the same country.'" (p. 135)

"In this book I am not so much saying: 'It is a grand thing to be able to claim descent from Sir George Villiers, Robert Barclay or those other sires' (though of course it is), as: 'Look what a fine posterity those sires have had—and consider what confidence and pride people of good stock should have in the prospects of their children and children's children.'" (p. 135)

"Galton's researches indicated that parenthood is of the first importance. Parents should have good health and physique, intelligence, a sociable and cooperative, disposition, freedom from hereditary taints, and the advantage of belonging to a large family in which the children had been wanted and were loved. There is nothing about 'blue blood' but Galton made it clear that it was prudent, so to speak, to choose *able* ancestors before one came into the world." (p. 137)

"T. H. Huxley went so far as to say that 'in view of the ravages of the terrible monster, over-population, all other riddles sink into insignificance.'" (p. 140)

"Huxley also once wrote, 'The sum of tendencies to act in a certain way, which we call 'character,' is often to be traced through a long series of progenitors and collaterals.'" (p. 141)

"As we study the history of the Villiers connection we can hardly resist the impression that Sir George had some wonderful potency, some fund of practical ability and

stubborn character and charm, which he was able to transmit to the increasing numbers of his descendants as if a few drops of the Villiers blood were sovereign against failure, especially for anyone in the family with political ambitions. In the case of the cousin-marriages among Robert Barclay's descendants it is natural to infer that inbreeding regularly revived the ancestral virtues." (p. 156)

"Lord Keynes wrote, 'each country needs a considered national policy about what size of population, whether larger or smaller than at present or the same, is most expedient. And, having settled this policy, we must take steps to carry it into operation. The time may arrive when *the community as a whole must pay attention to the innate qualities as well as the mere numbers of its future members*'—I have italicised these words since they sum up one of the beliefs in which this book is written." (p. 180)

"There is an instinctive desire for excellence. 'Aristocracy,' said Napoleon, 'always exists. Destroy it in the nobility, it removes itself to the rich and powerful houses of the middle class. Destroy it there, it survives and takes refuge with the leaders of the workshops and the people.'" (p. 199)

"Having a good I. Q. and sound health are not enough to put a child into the top flight of promising young citizens. There is such a thing as character: hard to define precisely, and not the sort of quality or bundle of qualities that necessarily comes to light under I. Q. testing and academic examinations." (p. 205)

"The blessing of a good home is obvious; to be one of a large and public-spirited family is an inestimable source of strength too." (p. 208)

"For common humanity to become a reality the meek will have to inherit the earth . . . Meekness would mean a character compounded of ability, courage and slowness to anger: the meek who are also the strong never press an advantage too far, a kind of forbearance which must be dimly understood throughout the lower part of the surviving Creation, since evolution would have come to a stop if it were not so." (p. 209)

"One of the best ways of doing this is to improve society—by improving the members of society. That is by acknowledging nature's disposition to let like beget like and by encouraging uncommon people, 'for with their seed shall remain continually a good inheritance.' Evidently the sage old Ecclesiasticus (who said this towards the end of his famous passage beginning 'Let us now praise famous men') was a bit of a eugenist, a forerunner of Sir Francis Galton." (p. 210)

An important part of Mr. Bloomfield's theme is that exceptional talents running in the family are a national asset. It would be bad policy to waste it when we have it, and short-sighted and unjust not to identify and encourage promising children starting life under unpromising conditions. They and their children could be uncommon people too.

Nearly every reader of *Eugenics Quarterly* will find considerable of interest in this volume, which is a worthy supplement to Galton's work.

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PERIODICAL ABSTRACTS

GENETICS

The incidence of cousin marriages in a West-Swedish rural community. J. A. Böök and C. -E. Mawe. *American Journal of Human Genetics* **7** (1955), pp. 426-429.

In a geographically isolated community of Ostmark the authors found about 1.25 per cent of all marriages to be between first cousins. In each of two geneological investigations, for 1925 and 1954, seven first-cousin marriages were discovered among 500-600 total marriages. During this period the area was undergoing gradual depopulation by decreasing fertility and by emigration, and fell from 4,148 in 1901-1910 to 3046 in 1941-50.

This rate of cousin marriage is high by any standards, but seems especially high because the average number of cousins available to choose from was computed to be less than two. The authors infer from this that population size, for the purpose of mate-selection, was between 100 and 300.

Cousin marriage rates have great importance by themselves in human genetics. Estimates of population size based upon them, however, are generally considered to be of dubious significance.

Possible genetic carriers in the spherophakia-brachymorphia syndrome. H. W. Kloepfer and J. W. Rosenthal. *American Journal of Human Genetics* **7** (1955): 398-425.

Deviations from normal in the direction of a recessive disease are the logical starting points in the search for healthy carriers of that disease. This principle has been applied to a rare but well-established deformity consisting of short stature, short fingers and severe eye defects. The authors have set up arbitrary limits of normality for four traits, and were then able to classify correctly eleven of twelve parents and offspring (all presumably carriers) of affected persons.

Genetics in the service of man. B. Glass. *The Johns Hopkins Magazine* **6** (1955), No. 5.

Despite its outstanding successes in medical bacteriology, in agriculture, and in explaining organic evolution, the science of genetics is still too young to be applied effectively in the improvement of man. As long as many important genes remain unexpressed in the population, eugenic measures are unable to act upon them. Many genes have good or bad effects according to what genes are combined with them in the same individual, and environmental effects also complicate the expression of heredity. Furthermore, most hereditary diseases could be completely eliminated only if the process of mutation could be stopped.

Yet certain problems appear to call for eugenic measures. By preserving deleterious genes, medical science is steadily increasing the load it must carry. The differential reproduction of economic and cultural groups appears to be depleting the genes which contribute to high intelligence, although a decline in intelligence has not been detected. Segregation or sterilization of defectives will not go far toward solving these problems. Extension of present rather difficult birth control methods might aggravate the intelligence differential in reproduction.

Positive eugenics must surely reject the use of artificial breeding methods, which are crucial in the improvement of agricultural plants and animals. The obvious alternative is to offer inducements and rewards for parenthood, and to remove impediments to it. Thus, manipulation of the environment is the safest approach to eugenics.

"It will be easier to define the essentials of an optimum environment . . . than to modify gene frequencies by wise selection. Once mankind has produced an approximation to that optimum environment, the eugenic task will be simpler. In fact, the natural selection exerted by such an environment may make other eugenics quite unnecessary."

Blood testing and the law. G. A. Friedman. *Medical Times* **84** (1956): 199-204.

Although the existence of blood groups has been known since the beginning of the century, they were not used in identification of blood stains until 1916, nor in paternity cases until 1924. As late as 1946 a jury found Charles Chaplain to be the father of a child whose blood groups excluded him as the father. The lag in legal application of medical facts has been ascribed to the hesitancy of lawyers to educate the courts in these matters, and to imperfect communication between the legal and medical professions.

Blood groups were first accepted as conclusively excluding paternity in this country in 1949, and their conclusiveness in this respect has now been established in a large number of

states. However, evidence must be given to show that the blood tests were carried out correctly and interpreted scientifically. In most states a defendant cannot refuse to submit to blood tests; blood testing is justified by its analogy with fingerprinting.

Although two Rh-negative parents cannot have an Rh-positive child, the converse, asserted by this author, is not true.

A note on the occurrence of single-sex sibships. Hewitt, D., *et al. Annals of Human Genetics* **20** (1955), pp. 155-158.

The frequent occurrence of families with a great preponderance of girls or boys has led to several investigations of this phenomenon. The conclusion, in general, has been that such families occur only about as often as expected by chance.

In a new approach to the problem the authors concentrated attention on *large* families of *all* boys or *all* girls. This revealed a highly significant excess of sibships with five or more boys, but no excess of families with all girls. Among 3909 Northamptonshire families, 8.4 were expected to contain five or more boys and no girls, but 16 such families were found.

Epidemiological investigators of amyotrophic lateral sclerosis. II. Familial aggregations indicative of dominant inheritance. L. T. Kurland and D. W. Mulder. *Neurology* **5** (1955), pp. 182-196 and 249-268.

Amyotrophic lateral sclerosis is a progressive paralysis that occurs in middle life and is fatal usually within three years of the date of onset. In the last century it was regarded as hereditary in nature, but this view has been discarded in the past 50 years.

The disease is about 100 times as frequent among the natives of Guam as in Europe and America, and shows a familial tendency there. A review of medical literature reveals 18 pedigrees involving 90 affected persons, and the authors added six new pedigrees from the Mayo Clinic with 34 affected. The disease varies within families and occasionally skips a generation. Simple dominant heredity appears to account for at least a small portion of all cases, but most patients give a negative family history.

The use of fertilities of affected individuals and their unaffected sibs in the estimation of fitness. R. S. Krooth. *American Journal of Human Genetics* **7** (1955): 325-367.

Natural selection reduces in frequency, or eliminates, some deleterious genes principally by the agency of reduced fertility of persons with the disorder. The reduction in fertility is generally measured by comparing the fertility of affected individuals with that of their siblings. However, when one uses fertility in sibships of all sizes, the large families tend to bias the result of contributing a large number of very fertile siblings. Consequently, this method underestimates the relative fertility of affected people.

The author develops a mathematical approach to overcome this bias. Practically, what his method accomplishes is the weighting of fertility data on affected persons according to the size family they come from. Each family thus contributes equally to both estimates of fertility: that for normals and that for affected persons.

Theoretical exploration of problems like this is an important part of research in human genetics. The complexities of human reproductive behavior cannot be by-passed with human guinea pigs and must be met at their own level of complexity. The bias which Krooth's method is designed to eliminate might be inconsequential, but hitherto no methods were available even for measuring it.

Observations sur l'hérédité des idioties amaurotiques et de la spléno-hépatomégalie lipidienne. L. van Bogaert and D. Klein. *Journal de Génétique Humaine* **4** (1955), pp. 23-78.

Amaurotic idiocy, properly known as cerebral lipidosis, refers to a complex group of hereditary disorders in which accumulation of fatty substances in the brain causes progressive blindness and mental deterioration. The authors studied the disease in eleven families, several of which had affected children in more than one fraternity. Within single fraternities the age at onset of symptoms was found to vary over a wide range. Tay-Sachs disease, the best known type in this country, began as early as two months after birth in some cases and as late as 10 months in others. Some cases lacked the typical cherry-spot in the eye. One child with Tay-Sachs disease had two sisters with Niemann-Pick disease, which is usually regarded as a separate form of lipidosis. Another family demonstrated that cerebral lipidosis may sometimes be transmitted as a dominant, instead of as a recessive disease, but in this family there was no blindness. The findings in these families indicate that sharp clinical distinctions cannot be made between the several recognized forms of cerebral lipidosis.

Chromatographic studies on urinary excretion patterns in monozygotic and dizygotic twins. H. K. Berry *et al.* (Part I) and S. M. Gartler *et al.* (Part II). *American Journal of Human Genetics* **7** (1955), pp. 93-121.

The amino acid, threonine, varies in the urine of different persons chiefly as a result of genetic differences. Most amino acids, however, fluctuate so widely from day to day that definite evidence for hereditary variations could not be obtained in this study.

The authors analyzed the urine of 11 dizygotic, 15 monozygotic and one doubtful pair of twins. With respect the threonine, the variance within DZ twin pairs was 21.6 times as great as that within MZ twin pairs. The study confirmed the already-known heritability of excretion of beta-amino-isobutyric acid. Two other amino acids, alanine and glycine, also showed some evidence of inheritable differences.

Comparison of twins living together with twins living apart revealed that separation scarcely affects the differences in MZ twins, but exaggerates the already large differences in DZ pairs. Since most of the substances studied are more or less affected by diet, the authors conclude that the relevant hereditary differences between fraternal twins may be partly psychological. These are expressed in choice of environment and diet and thus indirectly in urinary excretion patterns.

Expression of the sickle cell gene in Africa. G. M. Edington and H. Lehmann, *British Medical Journal* 1955 **1**, pp. 1308-1311.

In American Negroes, sickle cell anemia is such a severe disease that affected persons would rarely be expected to have children. Yet it is known that in African Negroes the gene responsible for the disease is very common. This has been attributed to increased malaria resistance in carriers.

It has been generally supposed that severe anemia occurs exclusively and inevitably in homozygous persons. These homozygotes can be distinguished from heterozygous carriers by electrophoretic analysis of the blood pigment, hemoglobin. The authors studied the blood of 200 healthy African natives and found two healthy *homozygotes* among 38 carriers. On the other hand, in a series of natives with acute sickle-cell disease, they found some heterozygous persons who should have been healthy. The authors had previously noted that Gold Coast natives who survived sickle cell anemia during childhood became more vigorous in later life. Consequently, the effect of natural selection on the frequency of this disease in Africa may be more difficult to calculate than was formerly supposed.

CORRECTION

In the March issue an abstract was given of a paper by Bruno Schulz on "Gifted Germans of Jewish descent and their relatives." The last paragraph was minintrepreted by many readers, and its intended meaning is better conveyed in the following statement:

Among the Jewish index cases and their wives Schulz found proportionately more cases of manic depressive psychosis and the children showed relatively more schizophrenia that in the non-Jewish series, but the number of cases of psychopathology was too small to be statistically significant even in comparison with the general population of Jews. However, the families of gifted Jews, like those of gifted non-Jews, were clearly distinguished by a high incidence of talent.

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POPULATION

The rhythm method: two Indian experiments. C. P. Blacker. *Eugenics Review*, **47**, Nos. 2-3, (July, Oct. 1955), pp. 93-105, 163-172.

A summary of the commentary upon the WHO publication *Final report on pilot studies in family planning* (New Delhi, 1954), this two-part article is concerned with field experiments with the rhythm method organized by WHO at the request of the Indian Government and carried out in the rural area of Ramanagaram in southern India and the urban Lodi colony on the outskirts of New Delhi. Information was sought on three points: the acceptability of the rhythm method, the effectiveness of the method for those who used it, and (in the case of Ramanagaram) its effectiveness in reducing the birth rate of the community.

On the basis of attitude studies that preceded the introduction of the method, it appeared that 75 per cent of the women interviewed in each place were interested in obtaining information about family planning, a much larger fraction than had been anticipated. Of the 1709 women who expressed an interest in learning the rhythm method, only 68 (4 per cent) were following the method regularly at the end of the observation period of somewhat less than two years. The small amount of evidence that was thus able to be collected indicated that, in very round numbers, the

number of exposure-months per pregnancy was about 50 for those following the method, as compared with about 20 estimated for an unprotected rural Indian population. The birth rate of Ramanagaram rose during the experiment.

From these results it is concluded that the evidence as to the acceptability of this particular method was "scarcely favourable" (p. 167). This seems to have resulted in part from the long period of observation and substantial abstinence required by the chief procedure used at Ramanagaram. For those actually using the method it is judged to have been "moderately effective," but the author asserts that "it can be confidently said that the routine rhythm method as there taught will have no perceptible effects on the birth rate of the rural population of India unless it can be simplified and somehow made more generally acceptable" (p. 168).

The author offers as his main conclusion that, although they were abruptly terminated and yielded results that were disappointing to many, the experiments were thoroughly worth while. With this the reviewer would concur, though, as is often the case, it is possible with the advantage of hindsight to imagine ways in which they might have been improved.

Recent population developments in Japan: some facts and reflections. Irene B. Taeuber. *Pacific Affairs,* **29,** No. 1 (Mar. 1956), pp. 21-36.

In this latest of an extensive series of articles on the Japanese population, Dr. Taeuber describes the revolution in vital rates that has occurred in Japan since the second World War and comments upon its possible implications for other areas. Between 1947 and 1954, she reports, the crude birth rate fell from 34.3 per thousand to 20.0, and the crude death rate from 14.6 to 8.2. In consequence, the annual rate of natural incease has declined from 2.0 per cent to 1.2 per cent, and a cessation in population growth by about 1990 seems probable. Important problems will still remain, however, including that of finding employment for 70 per cent more men in the productive ages.

The reduction of mortality has come through the introduction of new medical technology into a society long concerned with the improvement of health. The fertility decline has been the indirect result of action in the medical and health fields and of permissive legislation with respect to abortion and contraception rather than the outcome of a population policy as such. Though an increase in the use of contraception has occurred, the decline in the birth rate is clearly related to the great increase in abortions. In 1953, abortions reported to the proper authorities numbered 572 per thousand live births. The spread of this method of limiting births appears to have depended on its moral acceptability in the culture and the absence of medical and economic deterrents often found in the West.

The relevance of the Japanese experience for other countries is limited by the fact the shortage of doctors makes abortion unavailable as a safe procedure in other areas of Asia. It might be that new advances in fertility control would find wide acceptance, though it is not easy to judge whether other countries will be as concerned about population as Japan. The author concludes that "it is quite possible that in many countries, as in Japan, decisive action may replace public apathy and thus greatly diminish the magnitude of the problem and lessen the period during which sheer numbers will endanger advancing levels of living" (p. 36).

Family structure and fertility in Puerto Rico. Reuben Hill, Kurt W. Back, and J. Mayone Stycos. *Social Problems,* 3, No. 2 (Oct. 1955), pp. 73-93.

This interim report on a study sponsored by the Social Science Research Center of the University of Puerto Rico gives a description of the analytical framework that was developed for the study and a report of some of the findings. The entire project is viewed as having three stages: exploration and development of hypotheses, quantitative verification of the hypotheses, and experimental validation of the conclusions by an attempted application of the results. This article is concerned with the second of these phases.

The data were obtained in individual one- to two-hour interviews with all the wives and one-third of the husbands of 888 families of proven fertility and less than sixth grade education. The hypotheses tested were grouped under four major categories relating to the effects of (1) the demographic and other groups to which an individual belongs, (2) general motivation, (3) family organization as it facilitates action, and (4) specific informational and attitudinal attributes. In all, some 81 subhypotheses were tested, of which 47 were judged to have been supported by the data and 5 significantly reversed. The authors conclude that "it is possible to glean from the foregoing pages that the following factors are important for effective [family] planning: 1)

a general 'modern' value system; 2) definite views favoring small families; 3) sufficient information on birth control methods and favorable attitudes toward using them; and 4) effective family organization" (p. 82).

In weighing the implications of their findings, the authors stress the need for both motivation and appropriate organization of the family if birth control is to be practised successfully. It is their view that the motivation to start birth control already exists rather widely in Puerto Rico. The problem is to facilitate regular practice.

The reviewer believes that readers will find this article a useful reference point for relating to each other the various reports on this study that have been appearing from time to time. (Bibliography, p. 83). Unfortunately it packs so much into a small space, especially through the use of tables, that its full implications are not always readily grasped. Some avoidable obscurities add to the difficulty. (E.g., a statement on page 81 about "four of five hypotheses" in "Table 5" appears to refer to Table 4, which lists six hypotheses.) The final report of the study will have the advantage of more space and of the results of further analysis of the data, and will be awaited with much interest.

Studies in child spacing: IV. The time-interval separating all children in completed families of Purdue University graduates. Gerald R. Leslie, Harold T. Christensen, and Glenn L. Pearman. *Social Forces,* **34,** No. 1 (Oct. 1955), pp. 77-82.

The contribution of this article lies both in a statement of the results of a mail questionnaire study of the graduates of Purdue in the Classes of 1927 and 1928 and in a comparison of these results with the findings of similar studies reported in the literature. The comparison leads to a suggestion as to possible differential effects of various methods of collecting data about child spacing.

Of the 917 graduates in the two classes, 396 furnished complete information on number of children born and the intervals separating the births. Among these families, exactly half reported two children. None had more than six. The mean interval between marriage and first birth was 3.3 years. The successive intervals to later births tended to be longer up to the third birth and then shorter again for higher orders.

A notable difference among the studies examined was the variation in the findings as to the interval between marriage and first birth. It appeared that a shorter interval was found when the investigation included a cross-check with vital statistics records. While there may have been true differences among the populations, and authors believe that it is "at least equally plausible" that studies depending entirely on questionnaires, census-type schedule filling, or interviews are considerably biased by attempts to conceal premarital pregnancies.

Population and progress. Colin Clark. *Queens Quarterly,* **62,** No. 3 (Autumn, 1955), pp. 411-422.

This article, writen for the lay audience by the Director of the Institute for Research in Agricultural Economics at Oxford University, expresses the view that increases in population have not been, and will not foreseeably be, a serious problem for the world. In the past, it is suggested, populations have had a tendency to decrease rather than increase. "Malthus's concept of populations always tending to increase until they reach the limit of subsistence is entirely out of accord with all historical and geographical evidence." (p. 417). Countries of the Middle East that have lost population have done so as a result of misgovernment rather than a shortage of natural resources. Attention to various examples leads to the generalization that "increasing population pressure, so far from being an evil, provides that beneficial if somewhat painful stimulus without which men will not make the necessary effort to transform their society into a new industrial form, much more productive than its predecessor." (p. 421). Meanwhile, the technical capacity of the world to feed a population six or seven times its present size is assured.

The economic limits to population increase. W. M. Cordon, *The Economic Record,* **31,** No. 61 (Nov. 1955), pp. 242-260.

This is a theoretical discussion of certain aspects of the interrelationships among population size, national product, and the international balance of payments. In spite of the broader implications of the title, it is largely concerned with a static analysis of the effects of a single large unit of immigration on an economy such as that of Australia. Among the conclusions reached are these: (1) Because of the need for investment if new immigrants are to be used with full effectiveness, a choice must be made between a short-term fall in average real consumption and a long-term fall in average real income. (2) The population increase may lead to unavoidable inflation. (3)

Unemployment resulting from immigration does not provide an absolute limit to population increase, because of the possibilities for sharing the work and for redistributing income. The author suggests that the analysis "could readily be extended to a dynamic model which allows for rates of population increase, capital formation and technical progress, and for the expectation by the community of a gradually rising standard of living." (p. 259). In view of the importance of these variables, the reviewer hopes that such an extension of this interesting analysis will be made.

GEORGE F. MAIR
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NEWS NOTES

First International Congress of Human Genetics

(Copenhagen; August 1-6, 1956)

According to the most recent information received from the congress office (Tagensvej 14, Copenhagen N.), satisfactory progress has been made in the organizational arrangements for the first international congress of scientific branches concerned with the clinical and experimental aspects of human genetics. Owing to the most thorough planning of Prof. Tage Kemp and his staff, the preparatory work has reached a point where the prediction of a successful meeting is no longer a matter of speculation.

Since the active participation of leading experts from many countries has long been assured, it is a particular pleasure to report that the size of the American contingent will be respectable. Nearly fifty geneticists from the United States have paid their enrollment fee (Danish kroner 225.— for full members since April 1, 1956), and new membership applications are still being received every day. This last-minute rush necessitated a slight delay in the printing of the final program.

The scientific meetings and exhibitions will be held at the Institute of Medical Anatomy, 63 Norre Alle, Copenhagen North, with a maximum time limit of 15 minutes for each paper. Presentation of papers in the English language has been recommended, although French and German will also be official languages of the congress. Simultaneous interpretation has been arranged for all important sessions.

The topics of the plenary sessions (forenoon) will include the following: Mutation in man and Radiation genetics and its human implications (August 1); Comparative and experimental pathology in relation to human genetics and Genetics and medical research (August 2); Methods in human genetics (August 3); Biochemical genetics (August 4); and Social applications of human genetics and Epidemiological control of hereditary diseases (August 6). Sectional afternoon meetings on August 1, 2, and 3 will deal with specialized genetic problems in internal medicine; etiology of cancer; psychiatry, neurology, and psychology; biochemistry; anthropology; blood groups; ophthalmology; odontology; and population genetics. An excursion to Elsinore is planned on Sunday, August 5.

Final arrangements for the social part of the congress have yet to be completed. In addition to an official banquet (probably on August 4), there will be a City Hall reception and several other festivities. Formal dress will be optional.

Although the hotel situation may prove to be difficult, the congress office will accept applications for living accommodations (Form D) until June 20, 1956. Tours before and after the congress may be arranged through Dantourist, the official travel agency.

COMMITTEE ON INTERNATIONAL MEETINGS,
American Society of Human Genetics

Interest in Population Growing

Recent reports of organizations dealing with population problems indicate growing public concern. A marked increase of interest in population discussion on a number of levels has taken place this last year, according to the annual report of The Population Reference Bureau.

Population is becoming an increasingly important consideration in government, the report states. Understanding is spreading that the nation's foreign policy is inseparably linked to the population problem. Population is also coming into its own with the press and radio of the nation. An increasing number of newspaper, magazine, radio, and TV channels look to Popu-

lation Reference Bureau materials as guideposts in the area of population.

Population has also become respectable at the level of the community forum, the Bureau finds, and it is becoming more and more an important part of the curriculum of some colleges. It is also being given a major emphasis in the thinking and planning of national, state, and community social, welfare and health agencies. More and more of these groups are realizing that a completely new orientation is needed now if the nation is to meet the challenge posed by an aging population. And a few far-sighted industrialists are beginning to question the premise that a continually booming birth rate means a continually expanding economy.

The Population Reference Bureau views all these signs as the beginning of a new era, concludes Robert C. Cook, Director.

The annual report of The Conservation Foundation states that the year 1955 has been remarkable for the increasing consideration of natural resources and population problems in various parts of the world. The most significant factor, the report concludes is the increased recognition of the extraordinary uptrend in human populations both in industrial nations and in the underdeveloped regions.

The Population Council, Inc., a nonprofit group concerned with population problems, is assisting a number of important projects in the field of population. Incorporated in 1952, John D. Rockefeller III is Chairman of the Board of Trustees of The Council and Frederick Osborn is Executive Vice President. The following projects have received financial assistance from The Council.

1. *Family Life in Puerto Rico:* a major study of family attitudes and practices in Puerto Rico under the auspices of the Social Science Research Center of the University of Puerto Rico. Studies so far indicate a general ideal of three children even among families with more. Lack of communication or discussion on such matters between husband and wife is of crucial importance in the Puerto Rican situation. The final project, now approaching completions, includes tests of various methods of education in family planning.

2. *Jobs and People in Puerto Rico:* a study under Dr. A. J. Jaffe of the Bureau of Applied Social Research of Columbia University, conducted in collaboration with the Puerto Rican Department of Labor and other Puerto Rican agencies.

3. *Abortion in Japan:* experiments on education in family planning in a mining village and in a poverty-stricken ward of Tokyo under the Department of Public Health Demography, a branch of the National Institute of Public Health. This project is being conducted under Japanese initiative and direction.

4. *Rural Field Study in India:* under the All-India Institute of Hygiene and Public Health to determine whether community birth rates in two groups of villages in West Bengal can be reduced significantly by education in simple inexpensive methods of regulating family size. This study will be managed and staffed by Indian public health personnel.

5. *Training Survey Personnel in Egypt:* under the Egyptian National Commission for Population Studies, Permanent Council for Public Welfare Services. This will advance the training in Egypt of field workers to collect special demographic and related information.

6. *Social and Psychological Factors in Fertility:* a study under the auspices of the Milbank Memorial Fund which is investigating social and psychological characteristics of couples prior to childbearing, rather than afterwards as in the earlier Indianapolis Study. It will cover the post-war period of high fertility and increased economic activity.

7. *Cohort Fertility:* under the direction of Dr. P. K. Whelpton at The Scripps Foundation for Research in Population Problems. Dr. Whelpton has developed new techniques in analyzing current birth information by order of birth to estimate the final size of family. This new study extends his material on the order of births (cohorts) to the total population.

8. *Growth of American Families:* a study on current fertility expectations of American women jointly by the Survey Research Center of the University of Michigan and the Scripps Foundation for Research in Population Problems. Material is now being analyzed and prepared for publication.

9. *Trends in Size of Family by Social Class:* under the direction of Dr. Clyde V. Kiser of the Milbank Memorial Fund. Trends in differential fertility are being analyzed from the final tabulations of the 1950 census.

10. *Population Center at the University of Chicago:* a newly formed group under Dr. Philip M. Hauser. These projects are underway (1) study of statistics from the censuses of Burma in relation to its problems as an underdeveloped country; (2) experimental international studies of population distribution; (3) preparation of a laboratory manual of population analysis.

11. *British Population Investigation Committee:* the leading institution of population research in Great Britain. The Population Council is supporting its work over a three-year period, including the publication of *Population Studies.*

12. *Studies of European Migration:* under the Research Group on European Migration Problems established at The Hague in 1951. The Research Group issues a bulletin and sponsors a research program. It has published a series of eleven migration studies.

New Journals

A new monthly journal, *Contemporary Psychology: A Journal of Reviews,* published by the American Psychological Association, provides reviews of books on psychology and related fields. Edwin G. Boring of Harvard University has been named editor. Subscription is $8.00 a year, and Volume I begins with January 1956.

The American Sociological Society announces the publication of *Sociometry: A Journal of Research in Social Psychology.* Founded in 1937, this quarterly journal became an official publication of the Society in March 1956. Leonard S. Cottrell, Jr., social psychologist of the Russell Sage Foundation, is the new editor. The annual subscription rate is $9.00.

A.E.S. Directors

Mrs. Dorothy Brush, Editor of *News of Population and Birth Control* and a newly elected director of the American Eugenics Society, has been made Chairman of the Brush Foundation for Race Betterment in Cleveland, Ohio.

Frederick Osborn, Secretary of the American Eugenics Society, delivered The Galton Lecture, "Galton and Mid-century Eugenics," to the British Eugenics Society in London in February 1956. He also spoke to a French Parliamentary committee in Paris in the same month on the social sciences.

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Correspondence pertaining to membership in THE AMERICAN SOCIETY OF HUMAN GENETICS or to general society affairs should be addressed to the Secretary of the Society, Eldon J. Gardner, Department of Zoology, Utah State Agricultural College, Logan, Utah.

PLAN TO ATTEND

THE

Ninth Annual Meeting

OF THE

AMERICAN SOCIETY OF HUMAN GENETICS

The meeting will be held at University of Connecticut, Storrs, August 27-29, 1956. It will be a part of the annual program sponsored by the American Institute of Biological Sciences.

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European Heredity Registers, Jan A. Mohr
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Dynamics of Human Populations, Dudley Kirk
Perspectives in Population Eugenics, Gordon Allen, M.D.
Relation of Population Changes to Distribution of Genetic Factors: World Population Conference Report
Tested Intelligence and Family Size, Anne Anastasi
Future Fertility of American Women, P. K. Whelpton
Female Sterilization in Puerto Rico, J. Mayone Stycos
Effects of Differential Fertility on Genetic Endowment, Frederick Osborn
Heredity and Learning Ability in Infrahuman Mammals, J. P. Scott
Trends in Capacity for Intelligence, Frank A. Lorimer
Address of Pope Pius XII to Primum Symposium Geneticae
Effect of Birth Control on Intelligence and Character of Succeeding Generations, Frederick Osborn

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Hereditary Susceptibility in Rheumatic Fever, May G. Wilson, M.D.
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A great deal of interest has been shown in Eugenics Quarterly in countries outside the United States, and the journal is particularly glad to recceive contributions from overseas.

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